4. EVALUATION OF ALTERNATIVES AND IMPROVEMENT OPTIONS

This chapter focuses on the evaluation of reasonable alternatives that were identified after completion of the initial screening of options that was summarized in the preceding chapter. Included in this chapter is a discussion of the evaluation process and criteria, identification of the key findings for various design alternatives in each subarea, and a summary of conclusions that provides direction for the development of a recommended improvement strategy.

Each of the final improvement options/alternatives focused on specific types of improvements at the two I-5 interchanges, design options for a Scott Avenue crossing of I-5 and the BNSF railroad, improvements to SR 503 east of the I-5 interchange, and various other isolated intersections for which improvement needs were identified. Graphics illustrating the various improvements evaluated in this chapter are presented in Appendix D.

4.1 EVALUATION METHODOLOGY AND CRITERIA

4.1.1 Analysis Methodology

The assessment of final improvement options was conducted by determining how well each option satisfied a range of criteria that were developed to reflect the overall vision and guiding principles of the Woodland Transportation Improvement Strategic Plan. The assessment of each improvement options was based on the evaluation criteria that are discussed in the following section. The object of this assessment was to identify a "preferred" list of subarea improvement projects from which a recommended course of action for implementation over time (including specific intersection and interchange improvements).

4.1.2 Summary of Evaluation Criteria

Criteria used to conduct the evaluation of improvement options were based on the guiding principles described in Chapter 3 and reflected consideration for the following:

- **Congestion improvement –** Projected 2025 peak hour traffic operations in the study area with the Comp Plan Plus scenario were evaluated for a variety of design concepts using micro-simulation modeling techniques. Both signalized and roundabout traffic control options were considered as well as various lane channelization options. Results of this analysis were expressed in terms of average vehicle delays that would be experienced at key intersections since intersections typically reflect the major bottlenecks along arterial roadway corridors. Results are summarized and presented in Appendix E.
- **Reduction in traffic queues** – This analysis was derived from the analysis of traffic operations described above and reflects likely long lines at red lights or other delays in entering an intersection. Results of analysis are summarized and presented in Appendix E.
- **System wide Impacts** – This assessment focused on a discussion of the likely "system" impacts of improvement options. Often a roadway improvement at one location will result in shifting a congestion or safety problem to another location, particularly onto parallel streets. Additionally, some options could improve overall traffic operations in an area larger than the immediate project as they provide a new

or improved connection that did not previously exist, resulting in a better overall distribution of traffic.

- **Safety –** This criterion identifies the extent to which an improvement would enhance or detract from safety for all travel modes (types) in comparison to existing conditions. This assessment reflects an understanding of the known and likely impacts of various roadway and traffic control improvements.
- **Emergency vehicle impacts** – As emergency vehicle access and response times in portions of the city are a concern, the effect of various improvements on enhancing response times was considered. Additionally, design requirements for emergency vehicles were identified.
- **Right-of-way needs** – Several improvement options would require acquisition of right-of-way in order to build the improvement in a manner that enhanced safety, improved traffic operations, accommodated travel modes and provided a comfortable, attractive environment for users and residents alike. The general extent of likely right-of-way needs was determined for each option as this affects both cost and potential feasibility of the option.
- **Property access impacts** – Changes to existing patterns of property access were identified including both impacts through installation of a roadway median and enhancements by the provision of alternative or improvement access.
- **Environmental Impacts (noise, historic, natural resources, hazardous materials, etc.) –** A preliminary investigation of the potential for impacting natural resources and other environmental elements was conducted. For each alternative, impacts to biological resources, waters, hazardous materials sites, parks and trails, cultural and historic resources, and others were ranked to determine potential impacts and/or potential permitting issues or further analysis needs during implementation. No baseline noise data collection was included as part of this assessment and consideration should be given to do such during preliminary engineering of specific improvement projects as appropriate.
- **Accommodation of pedestrians/bicycles** - Bicycle and pedestrian modes of travel were evaluated to ensure a balanced approach to mobility throughout the corridor. Alternatives included expansion of bike lanes and sidewalks, and for safety.
- **Timeline to build -** Considerations related to cost, constructability, independence of project elements, and other factors related to funding and implementation of the alternatives were addressed.
- **Magnitude of costs –** This criterion focuses on addressing differences between the improvement alternatives that impact cost including such factors as utility issues, right-of-way needs/ potential land acquisition, and design issues/constraints. Additionally the potential for packaging of improvements into a comprehensive implementation strategy was also identified.

4.2 2025 PM PEAK HOUR TRAFFIC VOLUMES AND BASIS FOR ANALYSIS

This section presents a discussion of the future traffic projections that were prepared and evaluated to support the assessment of each interchange and/or subarea improvement option. Included is an overview of the traffic forecasting process (discussed in greater detail in the *"Woodland TISP Future Conditions Technical Memorandum"*, dated November 2007), the estimated 2025 PM peak hour intersection traffic projections, and the results of intersection and interchange traffic operations analysis.

4.2.1 Development of Traffic Forecasts

Traffic forecasts for the study area were developed to compare and assess the anticipated roadway system improvement needs. As noted in *Future Conditions Technical Memorandum*, traffic forecasts for the Woodland TISP were prepared using an updated version of the 2025 travel demand model that was originally developed to support the City's 2005 Transportation System Plan. Intersection level traffic forecasts were prepared for the weekday PM peak hour and volumes were rounded to the nearest five vehicles because weekday traffic levels tend to fluctuate from day-to-day. Typically, turning movement projections of less than seven are rounded to five. The turning movement volumes are not "raw" 2025 model volumes, but represent the 2025 model traffic volumes adjusted to reflect intersection level data calibration that was conducted using the procedures articulated in NCHRP Report 255[1].

The PM peak hour traffic projections are associated with two 2025 land development scenarios. The first (referred to as the Comp Plan scenario) is based on the existing adopted Woodland Comprehensive Land Use Plan which assumes an annualized population growth rate of 3.5 percent per year. The second land development scenario reflects more recent experience in community growth and assumes that population will grow by 4.5 per year from 2007 through the planning horizon year of 2025. The purpose of this second scenario is to test a "what if" condition which asks the question – "What would be the transportation impacts and infrastructure requirements if the current trends in land development and population growth were to continue through the entire planning period?" This second scenario was used as the basis for evaluation of roadway and interchange improvement options.

A further distinction was made in the development of future traffic projections for the evaluation of improvement options resulting in two sets of 2025 PM peak hour intersection level forecasts. The first set assumes that each subarea within the city would be improved independently of the other sub-areas. This analysis is based on the intersection traffic projections illustrated in Figure 4-1 (which are identical to those originally presented in Figure 3-2 of the *Future Conditions Technical Memorandum*). The second set assumes that improvements within each subarea are interrelated and reflect the effects of staged or collective implementation based on the traffic projections presented in Figure 4-2. For example, development of the Scott Avenue crossing would reduce travel demand at both I-5 interchanges and this is reflected in the volumes in Figure 4-2. Traffic operations analysis of this scenario acknowledges the reduced level of interchange improvement that would be needed if the Scott Avenue project were constructed.

4.2.2 2025 Peak Hour Traffic Operations Analysis

The traffic operations analysis provides a quantitative method for evaluating and comparing existing and future transportation alternatives. Traffic operations were evaluated based upon the LOS (level of service) methodologies of the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2000). The HCM is a nationally recognized and locally accepted method of measuring traffic flow and congestion. Criteria range from LOS A, indicating free-flow conditions with minimal vehicle delays, to LOS F, indicating extreme congestion with significant vehicle delays.

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[1] NCHRP Report 255 entitled "Highway Traffic Data for Urbanized Area Project Planning and Design" was published in 1982 by the Transportation Research Board's National Cooperative Highway Research Program. It is an authoritative reference on the post-processing of travel demand model data output to develop future intersection level turning movement forecasts.

4.2.2.1 Intersection Level of Service (LOS) Criteria

Signalized intersection LOS is defined in terms of the average total vehicle delay of all movements through an intersection. Vehicle delay is a method of quantifying several intangible factors, including driver discomfort, frustration, and lost travel time. Specifically, LOS criteria are stated in terms of average delay per vehicle during a specified time period (for example, the PM peak hour). Vehicle delay is a complex measure based on many variables, including signal phasing (i.e., progression of movements through the intersection), signal cycle length, and traffic volumes with respect to intersection capacity. Table 4-1 shows LOS criteria for signalized intersections, as described in HCM.

Table 4-1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (sec/veh)	General Description (Signalized Intersections)
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Source: Transportation Research Board, *2000 Highway Capacity Manual: Special Report 209*.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop-controlled and two-way stop-controlled. All-way, stop-controlled intersection LOS is expressed in terms of the average vehicle delay of all of the movements, much like that of a signalized intersection. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). This is because the performance of a two-way, stop-controlled intersection is more closely reflected in terms of its individual movements, rather than its performance overall. For this reason, LOS for a two-way, stop-controlled intersection is defined in terms of its individual movements. With this in mind, total average vehicle delay (i.e., average delay of all movements) for a two-way, stop-controlled intersection should be viewed with discretion. Table 4-2 shows LOS criteria for unsignalized intersections (both all-way and two-way, stop-controlled).

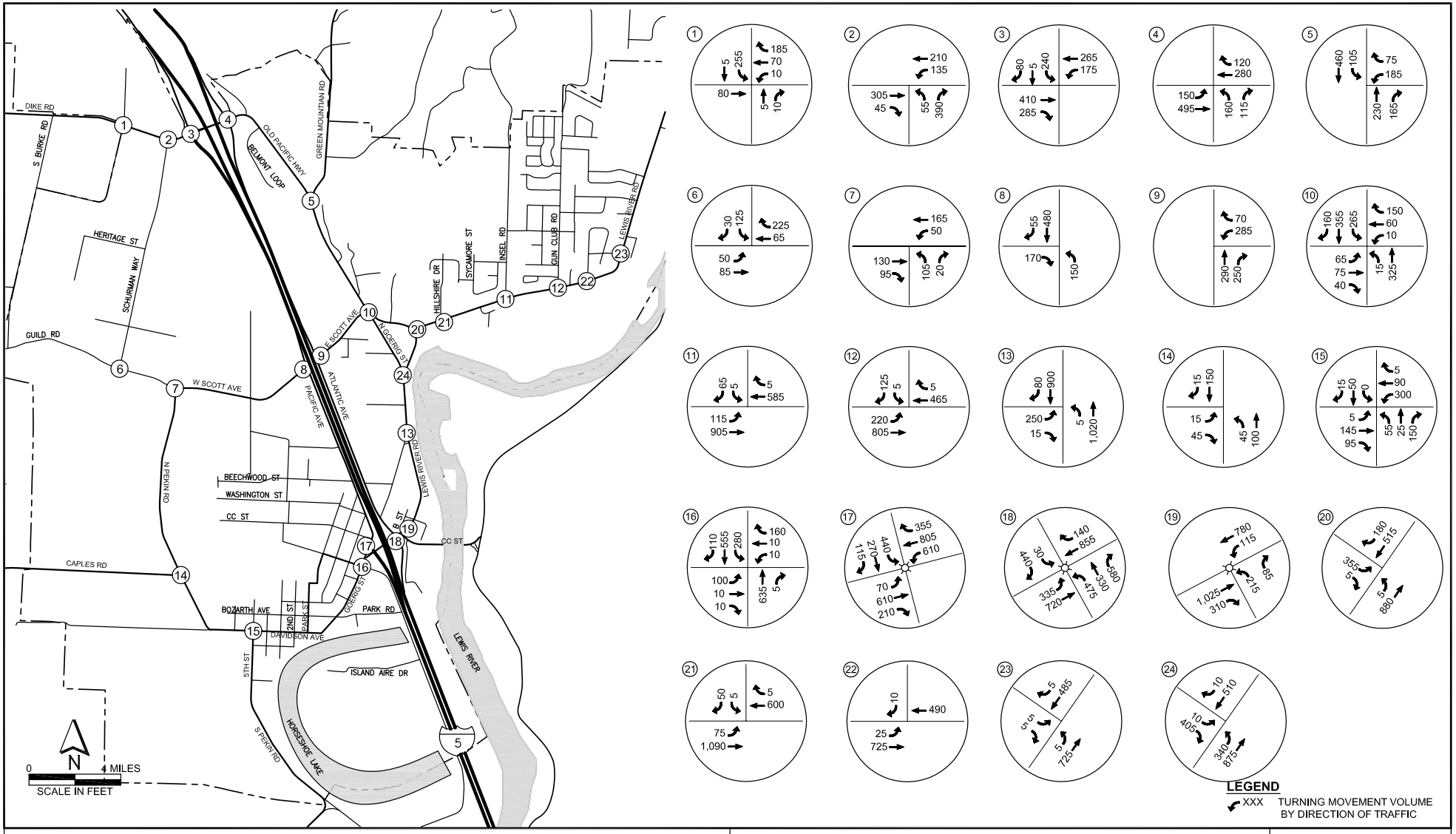
Table 4-2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (sec/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F	>50

Source: Transportation Research Board, *2000 Highway Capacity Manual: Special Report 209*.

4.2.2.2 Intersection Level of Service Standards

The Level of Service (LOS) standard is measured using methodologies identified in HCM. The level of service standard is LOS D or better on state highways, major arterials, and minor arterials. Acceptable levels of traffic on collectors and local streets are established through street design standards.



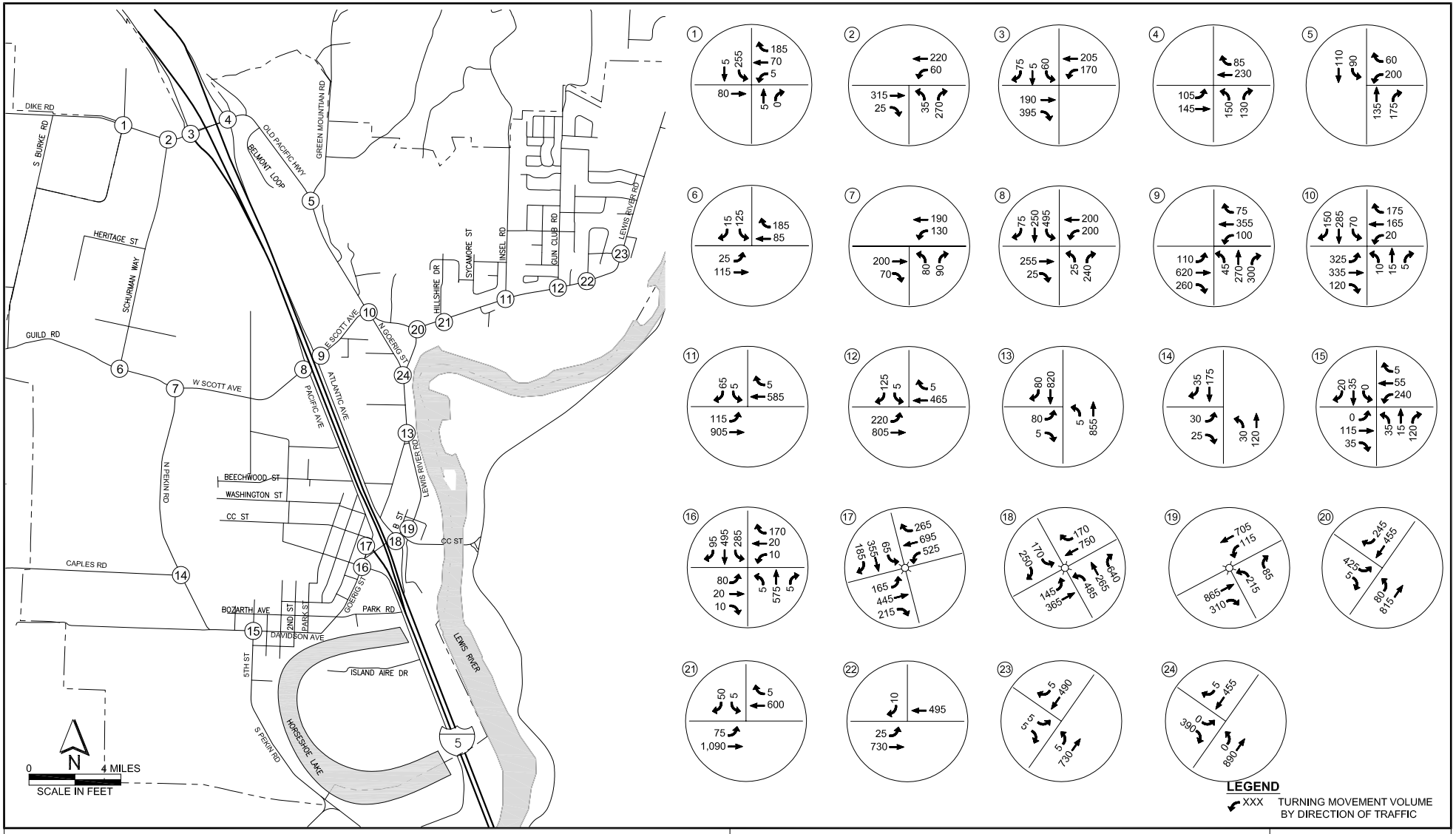
DATE: May 27, 2008 FILE: PO2398006F-17

Figure 4-1
Comprehensive Plan Plus 2025 Intersection Turning Movement Volumes

Woodland Transportation Strategic Infrastructure Plan

Parametrix

The Transpo Group



DATE: May 08, 2008 FILE: PO2398006F-64

Figure 4-2
Comprehensive Plan Plus 2025 Intersection Turning Movement Volumes With Scott Avenue Crossing

Woodland Transportation Strategic Infrastructure Plan

Parametrix

The Transpo Group

Pursuant to the requirements of Washington's Growth Management Act (GMA) requirements, CWCOG established levels of service standards for state highways within Cowlitz County. LOS C was established as the standard for Highways of Statewide Significance (HSS) in rural areas. For non-HSS facilities, CWCOG established LOS D for urban areas and LOS C for rural areas. Therefore, the city's LOS D standard would be consistent for SR 503 within the Urban Growth Area (UGA), with a LOS C standard outside the UGA. As the study area for the Woodland Transportation Infrastructure Strategic Plan is located within the City and the UGA; the LOS D standard applies.

4.3 2025 TRAFFIC OPERATIONS ANALYSIS RESULTS

Traffic operations analysis for the Woodland Transportation Infrastructure Strategic Plan focuses on key intersections located throughout the city. These intersections were also evaluated for the Woodland Transportation System Plan adopted in 2005 and in the earlier Woodland TSIP technical memoranda related to existing and future traffic conditions using traffic volumes that have been updated to 2007. The analysis of future weekday PM peak hour traffic operations was conducted using a Synchro traffic simulation model developed specifically for the study area intersections. For the evaluation of improvement options, this model includes a range of modified roadway channelization and intersection configurations to represent a variety of potential improvements.

4.3.1 2025 Intersection Operations for Improvement Options without the Scott Avenue Crossing

This section summarizes the results of traffic operations analysis for various improvement options assuming that the Scott Avenue crossing of I-5 and the BNSF railroad tracks is not constructed. This condition would continue to focus most traffic volume growth within the study area on the two existing I-5 interchanges, as well as along SR 503 and many other local streets, particularly those associated with the existing interchanges.

The analysis presented in this section focuses on improvement needs at each major interchange or subarea within the larger Woodland study area including:

- I-5/Dike Road interchange and vicinity
- I-5/SR 503 interchange and vicinity
- Intersections in various other parts of the city that require improvement based on 2025 PM peak hour traffic volume projections and no-build operations analysis

4.3.1.1 Traffic Operations with I-5/Dike Road Area Improvement Options

Figures D-1 through D-3 in Appendix D illustrate the major design concepts evaluated for the I-5/Dike Road interchange area. Table 4-3 presents 2025 PM peak hour traffic operations analysis results at the key study area intersections for these three interchange area improvement options. Data in this table includes LOS results, average delay per vehicle, volume-to-capacity (v/c) ratios, and critical movements where appropriate. Detailed level of service worksheets for these improvement options are presented in Appendix F. Table 4-4 presents a summary of traffic back-ups anticipated at each intersection for each option.

Analysis results presented in the table for Option 3B (which includes roundabouts at the three intersections in the Dike Road interchange area) are based on a micro-simulation using the Vissim software. This software allows an assessment of traffic operations under conditions which are as near to real world as can be evaluated using a simulation tool. The software accounts for the unique design features of each roundabout as well as a range of drive

behavior and vehicle mix while addressing the integration of each intersection into the whole corridor.

Analysis results presented in the table for the signalized improvement options (both with and without widening of Dike Road) are based on micro-simulation using the Synchro/Sim-Traffic software. This software provides an assessment of individual intersections under various traffic control schemes, as well as in conjunction with each other.

As indicated in the table, Option 3B (including single lane roundabouts at the three interchange area intersections) would provide for LOS A operations.

Option 4B1 reflects the no-build condition with stop signs for side street traffic and a single travel lane in each direction along Dike Road. This option would result in LOS F conditions at the interchange resulting in significant delay for vehicles attempting to turn from the freeway off-ramps. This option is not considered acceptable as a future course of action.

Table 4-3. 2025 PM Peak Hour Intersection Traffic Operations for Improvement Options in I-5/Dike Road Interchange Area

		Future (2025) Comp Plan Plus – Build Options			
Option/Intersection		**Critical Movement**	**Control Delay (secs/vehicle)**	**V/C Ratio**	**LOS**
Option 3B - Roundabouts					
2	Dike Access Road @ Schurman Way	--	2.3	--	A
3	I-5 SB Ramps @ Dike Access Road	--	4.7	--	A
4	I-5 NB Ramps @ Dike Access Road	--	5.0	--	A
Option 4B1 – Existing Stop Signs (No-Build)					
2	Dike Access Road @ Schurman Way	NB all	23.4	0.62	C
3	I-5 SB Ramps @ Dike Access Road	SB all	>100.0	2.46	F
4	I-5 NB Ramps @ Dike Access Road	NB all	>100.0	1.58	F
Option 4B2 – Signals without Widening Dike Road (1)					
2	Dike Access Road @ Schurman Way	--	61.0	0.46	E
3	I-5 SB Ramps @ Dike Access Road	--	42.9	0.86	D
4	I-5 NB Ramps @ Dike Access Road	--	16.0	0.79	B
Option 4B3 – Signals with Widening Dike Road (2)					
2	Dike Access Road @ Schurman Way	--	22.7	0.47	C
3	I-5 SB Ramps @ Dike Access Road	--	15.6	0.63	B
4	I-5 NB Ramps @ Dike Access Road	--	15.3	0.47	B
Option 5 – Signals with Widening Dike Road/Partial Access at Schurman Way (3)					
2	Dike Access Road @ Schurman Way	--	16.7	0.74	B
3	I-5 SB Ramps @ Dike Access Road	--	14.5	0.65	B
4	I-5 NB Ramps @ Dike Access Road	--	12.7	0.48	B

Note: NB means northbound, SB means southbound
(1) Results depicted in table are based on Synchro output. Evaluation of multi-intersection Sim-Traffic simulation indicates that traffic conditions without widening of Dike Road would likely exceed 100 seconds of delay per average vehicle with an average travel speed between Robinson Road and the I-5 northbound ramps of 2 mph.
(2) Evaluation of multi-intersection Sim-Traffic simulation indicates that average 2025 PM peak hour speeds along Dike Road corridor would be 20 mph.
(3) Evaluation of multi-intersection Sim-Traffic simulation indicates that average 2025 PM peak hour speeds along Dike Road corridor would be 21 mph.

Option 4B2 includes the addition of traffic signals at each intersection without widening Dike Road. This option was assessed to determine if this minimal improvement would accomplish the traffic operational objectives of the study while minimizing improvement costs. As indicated in the table, this option would not achieve adopted operational standards and would result in extensive traffic back-ups on Dike Road through the interchange area. This option was likewise not considered to be an acceptable future course of action.

Option 4B3 includes traffic signal improvements at each intersection along with the widening of Dike Road. This option would produce acceptable intersection operations if it included the provision of left turn lanes and a northbound right turn lane at Schurman Way, and left turn lanes along Dike Road and on the freeway off-ramps at the two ramp termini intersections. However, WSDOT has expressed concern over the proximity of the Schurman Way intersection to the freeway interchange. The assessment of traffic backups anticipated with this option indicates that eastbound traffic approaching the southbound on-ramp would like spill back to and interfere with operations at the Schurman Way intersection on a regular basis.

Option 5 was developed to address concerns about traffic spill backs between these two intersections. This option would preclude northbound and southbound left turns at Schurman Way, thus reducing the amount of signal time needed to serve Schurman Way traffic and improving traffic flow along Dike Road. However, some congestion and spillback between the southbound ramp and Schurman Way could still be anticipated.

Table 4-4. 2025 PM Peak Hour Traffic Queuing Summary for I-5/Dike Road Interchange Area Options

		Future (2025) Comp Plan Plus – Build Options		
Option/Intersection		**Movement**	**Available Storage (ft)**	**Queue Length (ft.)**
Option 3B - Roundabouts				
2	Dike Access Road @ Schurman Way	EB	> 1,000 ft	40 ft
		WB	350 ft	80 ft
		NB	> 1,000 ft	100 ft
3	I-5 SB Ramps @ Dike Access Road	SB	1,650 ft	120 ft
		EB Thru	350 ft	110 ft
		EB Right	170 ft	100 ft
4	I-5 NB Ramps @ Dike Access Road	WB	550 ft	40 ft
		NB	700+ ft	80 ft
Option 4B1 – Existing Stop Signs (No-Build)				
2	Dike Access Road @ Schurman Way	NB	>1,000 ft	120 ft
3	I-5 SB Ramps @ Dike Access Road	SB	1,650 ft	770 ft
4	I-5 NB Ramps @ Dike Access Road	NB	1,100 ft	490 ft
Option 4B2 – Signals without Widening Dike Road				
2	Dike Access Road @ Schurman Way	EB	>1,000 ft	1,030 ft
		WB	350 ft	150 ft (1)
		NB Thru/Left	>1,000 ft	>1,000 ft
		NB Right	200 ft	140 ft
3	I-5 SB Ramps @ Dike Access Road	EB	350 ft	**450 ft (1)**
		WB	630 ft	**740 ft**
		SB	1,650 ft	1,380 ft
4	I-5 NB Ramps @ Dike Access Road	EB	630 ft	**760 ft**
		WB	>1,000 ft	780 ft
		NB	1,100 ft	**1,480 ft**
Option 4B3 – Signals with Widening Dike Road (2)				
2	Dike Access Road @ Schurman Way	EB Thru	>1,000	280 ft
		EB Left	75 ft	60 ft
		WB Thru	350 ft	160 ft
		WB Left	225 ft	130 ft
		NB Right	150 ft	150 ft

Table 4-4. 2025 PM Peak Hour Traffic Queuing Summary for I-5 / Dike Road Interchange Area Options Continued

		Future (2025) Comp Plan Plus – Build Options		
Option/Intersection		**Movement**	**Available Storage (ft)**	**Queue Length (ft.)**
3	I-5 SB Ramps @ Dike Access Road	EB Thru	350 ft	**380 ft**
		EB Right	200 ft	180 ft
		WB Thru	630 ft	200 ft
		WB Left	250 ft	190 ft
		SB	1,650 ft	240 ft
4	I-5 NB Ramps @ Dike Access Road	EB Thru	630 ft	340 ft
		EB Left	210 ft	160 ft
		WB	>1,000 ft	240 ft
		NB	1,100 ft	170 ft
Option 5 – Signals with Widening Dike Road/Partial Access at Schurman Way				
2	Dike Access Road @ Schurman Way	EB	>1,000	210 ft
		WB	350 ft	140 ft
		WB Left	225 ft	160 ft
		NB Right	150 ft	200 ft
3	I-5 SB Ramps @ Dike Access Road	EB Thru	350 ft	**370 ft**
		EB Right	200 ft	190 ft
		WB Thru	630 ft	140 ft
		WB Left	250 ft	150 ft
		SB	1,650 ft	220 ft
4	I-5 NB Ramps @ Dike Access Road	EB Thru	630 ft	310 ft
		EB Left	210 ft	160 ft (1)
		WB	>1,000 ft	210 ft
		NB	1,100 ft	190 ft

Note 1: NB means northbound, SB means southbound, EB means eastbound and WB means westbound.
Note 2: Traffic queuing estimates based on multiple seed runs of Sim-Traffic and are based on 95 percentile confidence interval.
Bold type indicates locations where available vehicle storage space would be exceeded.
(1) Metered by adjacent intersection.

To test the ability of the roundabout options to meet future traffic volume increases in excess of that forecast under the 2025 Comp Plan Plus scenario, a sensitivity analysis was conducted assuming an increase in freeway-related traffic volumes of approximately 25 percent. This growth rate was selected to represent potential changes in land use designations near the interchange from industrial to highway commercial. The measures of both average vehicle delay / intersection levels of service, and potential traffic back-ups were evaluated. As indicated in Table 4-5, minimal delay is expected at the three interchange area intersections and all projected traffic queues will be well within available vehicle storage space.

Table 4-5. 2025 PM Peak Hour Intersection Operations for Roundabout Option in I-5 / Dike Road Interchange Area with 25% Added Traffic

		Traffic Operations Summary		
Option/Intersection		**Control Delay (secs/vehicle)**	**V/C Ratio**	**LOS**
Option 3B - Roundabouts				
2	Dike Access Road @ Schurman Way	3.6	--	A
3	I-5 SB Ramps @ Dike Access Road	9.0	--	A
4	I-5 NB Ramps @ Dike Access Road	10.5	--	B

Table 4-5. 2025 PM Peak Hour Intersection Operations for Roundabout Option in I-5/Dike Road Interchange Area with 25 % Added Traffic Continued

Option/Intersection		Traffic Queuing Summary		
		Movement	Available Storage (ft)	Queue Length (ft.)
Option 3B - Roundabouts				
2	Dike Access Road @ Schurman Way	EB	>1,000 ft	60 ft
		WB	350 ft	60 ft
		NB	>1,000 ft	140 ft
3	I-5 SB Ramps @ Dike Access Road	SB	1,650 ft	170 ft
		EB Thru	350 ft	270 ft
		EB Right	170 ft	100 ft
4	I-5 NB Ramps @ Dike Access Road	WB	550 ft	200 ft
		NB	700+ ft	190 ft

Note 1: V/C means volume-to/capacity ratio
Note 2: NB means northbound, SB means southbound, EB means eastbound, and WB means westbound.
Note 3: Traffic queuing analysis based on 95th percentile confidence interval.

4.3.1.2 Traffic Operations with I-5/SR 503 Area Improvement Options

Figures D-4 through D-6 in Appendix D illustrate the major design concepts evaluated for the I-5/SR 503 interchange area. Table 4-6 presents 2025 PM peak hour traffic operations analysis results at the key study area intersections for these three interchange area improvement options. Data in this table includes LOS results, average delay per vehicle, volume-to-capacity (v/c) ratios, and critical movements where appropriate. Detailed level of service worksheets for these improvement options are presented in Appendix G. Table 4-7 presents a summary of traffic back-ups anticipated at each intersection for each option.

Analysis results presented in the table for the No-Build Option indicate that, without improvements, significant traffic congestion resulting in LOS F conditions would be experienced by 2025 at all intersections through the interchange area.

Option 2B would involve development of multi-lane roundabouts at both of the existing freeway ramp intersections with stop sign control and limited movements to/from the Lakeshore Drive leg of the Buckeye Street/Goerig Street intersection. Access to/from CC Street would be made via a fifth leg at the roundabout for the northbound I-5 off-ramp/Atlantic Street. As indicated in the table, both of the freeway roundabouts would provide acceptable levels of service although higher delays would be experienced on Pacific Avenue for southbound traffic entering the roundabout. It should be noted that even with the restriction of Lakeshore Drive traffic to right-in/right out (e.g. no access via southbound Goerig Street), significant delay would be experienced at this intersection for the side streets.

A further consideration with this option is the size and scale of the two roundabouts both of which would have a minimum of two circulating lanes with some sections including three travel lanes. The complexity of these roundabouts would also create significant challenges for adequate signage.

Option 3B would involve a major widening of SR 503 through the interchange area to provide two through lanes in each direction and two sets of side-by-side dual left turn lanes. Traffic signals at the existing interchange ramps would be modified to accommodate the widened cross-section, a signal would be installed at the intersection of Goerig Street and Buckeye Street and the existing CC Street intersection with SR 503 would be relocated further east (at A Street) to provide greater separation between the northbound off-ramp and this intersection. As indicated in the table, all intersections through the interchange area

would operate at acceptable levels of services. However, this option would result in a very large road through this section of the city with resultant impacts on pedestrian and bicycle circulation. As with the roundabout option, this option may not be appropriate to the scale of the Woodland community.

Options 5 would entail development of a one-way couple on SR 503 through the interchange area with the existing roadway being used to accommodate westbound traffic and a new roadway between Buckeye Street and A Street being used for eastbound traffic. North and southbound traffic between the two east/west roads would be provided by one way streets aligned with the relocated freeway ramps. Southbound traffic would travel towards the southbound on-ramp, while northbound traffic would travel away from the northbound off-ramp creating a "box" of one-way traffic movement in the immediate vicinity of the freeway. Traffic signals would be installed at all four intersections within this box, as well as at Buckeye Street and CC Street which would be relocated to the existing A Street alignment. As indicated by the table, with this option all intersections in the interchange vicinity would operate at acceptable levels of service.

Table 4-6. 2025 PM Peak Hour Intersection Traffic Operations for Improvement Options in I-5/SR 503 Interchange Area

		Future (2025) Comp Plan Plus – Build Options			
Option/Intersection		**Critical Movement**	**Control Delay (sec/vehicle)**	**V/C Ratio**	**LOS**
No-Build Option					
16	Buckeye Street @ Goerig Street	EB	**>50.0**	**>1.00**	**F**
		WB	**>50.0**	**>1.00**	**F**
17	I-5 SB On-Ramp @ SR 503 (Lewis River Road)	**--**	**60.0**	**>1.00**	**E**
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Road)	**--**	**>80.0**	**>1.00**	**F**
19	SR 503 (Lewis River Road) @ CC Street	**--**	**>80.0**	**0.85**	**F**
Option 2B – Multi-lane Roundabouts					
16	Buckeye Street @ Goerig Street	--	46.5	--	E
17	I-5 SB On-Ramp @ SR 503 (Lewis River Road)	--	20.2	--	C
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Road)	--	18.8	--	B
Option 3B – Multi-lane Widening with Signals					
16	Buckeye Street @ Goerig Street	--	17.4	0.60	B
17	I-5 SB On-Ramp @ SR 503 (Lewis River Road)	--	34.6	0.80	C
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Road)	--	33.6	0.82	D
19	SR 503 (Lewis River Road) @ A Street	--	24.5	0.52	C
Option 5 – One-way Couplet					
16	Buckeye Street @ Goerig Street	--	13.1	0.70	B
	Pacific Avenue @ SR 503 (Lewis River Road)	--	12.8	0.53	B
	Atlantic Avenue @ SR 503 (Lewis River Road)	--	12.9	0.65	B
	I-5 SB On-Ramp @ SR 503 (Lewis River Road)	--	14.5	0.57	B
	I-5 NB Off-Ramp @ SR 503 (Lewis River Road)	--	14.0	0.68	B
	SR 503 (Lewis River Road) @ A Street	NB Right	9.5	0.01	A

Note: NB means northbound, SB means southbound, EB means eastbound, and WB means westbound.

Table 4-7 presents a summary of expected 2025 PM peak hour traffic queues (or back-ups) for major movements at all intersection for each alternative. This analysis was based on a 95 percentile confidence interval which means that 95 percent of the time during the peak period, traffic queues would be this length or less. As indicated in the table, by 2025, the No-Build Option would see significant traffic queues at the I-5 interchange with SR 503. East/west through movements in the interchange area would frequently back up from one intersection to the next, affecting traffic operations for the entire area. Additionally, the

northbound off-ramp opposite Atlantic Avenue would likely queue back onto the I-5 mainline creating a traffic safety problem for northbound through-moving traffic on the freeway.

Option 2B, which included the development of multi-lane roundabouts, would generally experience little traffic queuing with the exception of the southbound leg on Pacific Avenue heading into the intersection with SR 503. Traffic simulations conducted using Sim-Traffic indicated that this leg would likely experience backups similar to those experienced today.

Table 4-7. 2025 PM Peak Hour Traffic Queuing Summary for I-5/SR 503 Interchange Area Options

		Future (2025) Comp Plan Plus – Build Options		
Option/Intersection		**Movement**	**Available Storage (ft)**	**Queue Length (ft.)**
No-Build Option				
16	Buckeye Street @ Goerig Street	NB	200 ft	Nom.
		SB	300 ft	40 ft
		EB	200 ft	N/A (1)
		WB	400 ft	N/A (1)
17	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	EB Thru	300 ft	**420 ft**
		EB Left	150 ft	140 ft
		WB Thru	420 ft	**670 ft**
		WB Left	400 ft	**690 ft**
		SB Thru	>1,000 ft	260 ft
		SB Left	100 ft	**540 ft.**
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Rd)	EB Thru	400 ft	**450 ft**
		EB Left	200 ft	**560 ft**
		WB Thru	150 ft	(2)
		SB Left	50 ft	40 ft
		SB Right	>1,000 ft	480 ft
		NB Thru/Left	1,200 ft	**1,200 ft**
		NB Right	250 ft	**500 ft**
19	SR 503 (Lewis River Road) @ CC Street	EB Thru	50 ft	(2)
		WB Thru	>1,000 ft	520 ft
		WB Left	100 ft	**200 ft**
		NB Left	120 ft	**245 ft**
		NB Right	>1,000 ft	40 ft
Option 2B – Multi-lane Roundabouts				
16	Buckeye Street @ Goerig Street	EB Left/Right	210 ft	120 ft
		WB Right	200 ft	80 ft
		NB Left	50 ft	Nom.
17	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	EB Thru/Left	280 ft	200 ft
		EB Right	160 ft	50 ft
		WB	330 ft	60 ft
		SB Thru/Left	>1,000 ft	530 ft
		SB Right	200 ft	40 ft
18	I-5 NB Off-Ramp @ SR 503/CC Street	EB	310 ft	60 ft
		WB Thru/Left	250 ft	230 ft
		WB Right	250 ft	30 ft
		NB – ramp	1,200 ft	520 ft
		NB- CC	>500 ft	130 ft
		SB	>1,000 ft	130 ft

Table 4-7. 2025 PM Peak Hour Traffic Queuing Summary for I-5/SR 503 Interchange Area Options Continued

		Future (2025) Comp Plan Plus – Build Options		
Option/Intersection		**Movement**	**Available Storage (ft)**	**Queue Length (ft.)**
Option 3B – Multi-lane Widening with Signals				
16	Buckeye Street @ Goerig Street	NB Thru/Right	200 ft	**290 ft**
		SB Thru	300 ft	220 ft
		EB Left	200 ft	110 ft
17	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	EB Thru	280 ft	**320 ft**
		EB Thru/Left	280 ft	210 ft
		WB Thru	320 ft	**510 ft**
		WB Left	320 ft	240 ft
		SB Thru/Left	290 ft	**390 ft**
		SB Left	290 ft	**330 ft**
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Rd)	EB Thru	320 ft	**360 ft**
		EB Left	320 ft	**350 ft**
		WB Thru	350 ft	80 ft (2)
		WB Thru/Right	350 ft	**530 ft**
		SB Left	200 ft	160 ft
		SB Right	>500 ft	340 ft
		NB Thru	400 ft	**960 ft**
		NB Left	1,200 ft	**1,300 ft**
		NB Right	150 ft	**630 ft**
	SR 503 (Lewis River Road) @ A Street	EB Thru	370 ft	**390 ft (2)**
		EB Right	380 ft	**530 ft**
		WB Thru	>1,000 ft	**1,560 ft**
		WB Left	500 ft	**1,500 ft**
		NB Left	260 ft	**760 ft**
		NB Right	280 ft	100 ft
Option 5 – One-way Couplet				
16	Buckeye Street @ Goerig Street	NB Thru/Right	200 ft	**540 ft**
		SB Thru	350 ft	150 ft
		EB Left	100 ft	90 ft
	Pacific Avenue @ SR 503 (Lewis River Rd)	WB Thru	200 ft	**240 ft**
		WB Left	200 ft	100 ft
		SB Thru/Right	400 ft	160 ft
	Atlantic Avenue @ SR 503 (Lewis River Rd)	WB Thru	430 ft	90 ft
		NB Thru	110 ft	**480 ft**
		NB Left	110 ft	30 ft
		SB Right	400 ft	50 ft
	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	EB thru	270 ft	170 ft
		EB Right	130 ft	50 ft (2)
		SB Thru/Right	110 ft	**260 ft**
		SB Left	110 ft	**180 ft**
	I-5 NB Off-Ramp @ SR 503 (Lewis River Rd)	EB Thru	220 ft	180 ft
		EB Left	130 ft	40 ft
		NB Thru	1,200 ft	180 ft
		NB Right	400 ft	340 ft
	SR 503 (Lewis River Road) @ CC Street	EB Thru	490 ft	Nom
		NB	500 ft	Nom

Note 1: NB means northbound, SB means southbound, EB means eastbound, and WB means westbound.
Note 2: **Bold** type indicates locations where available vehicle storage space would be exceeded.
(1) Cannot be measured due to extensive delays for this movement.
(2) Metered by signal at adjacent intersection.

Option 3B included major widening of SR 503 through the interchange including reconstruction of the I-5 bridge and ramps. However, even with an 8-lane cross-section between the two interchange ramps, significant traffic queuing would be experienced. This would affect overall intersection traffic operations, reducing the effective level of service below the values indicated in Table 4-6.

Option 5, the one-way couplet between Buckeye and A Streets, would provide acceptable traffic queuing for most movements with available storage space expected to be exceeded in only a few locations.

4.3.1.3 Traffic Operations with SR 503 Improvement Options

Figures D-11A through D-11E in Appendix D illustrate the major design concepts evaluated for SR 503 between Goerig Street and to Evergreen Lane. Table 4-8 presents 2025 PM peak hour traffic operations analysis results at the key study area intersections for this improvement option. Data in this table includes LOS results, average delay per vehicle, volume-to-capacity (v/c) ratios, and critical movements where appropriate. Detailed level of service worksheets for these improvement options are presented in Appendix H. Table 4-9 presents a summary of traffic back-ups anticipated at each intersection for each option.

As discussed in Chapter 3, the evaluation of alternative improvements at intersections along SR 503 focused on two locations: SR 503 at Goerig Street and SR 503 at Scott Avenue where future traffic operational problems had been identified. At other locations along the SR 503 corridor, it has been recommended that a continuous two-way left turn lane along with bicycle lanes and sidewalks be provided between Hillshire Drive and Evergreen Lane to enhance traffic safety.

Intersection improvements considered included:

- Option 1 – Signalization of the SR 503 (Lewis River Road)/N Goerig Street and SR 503 (Lewis River Road)/E Scott Avenue intersections. Provide an exclusive eastbound left-turn lane at the E Scott Avenue intersection with SR 503.
- Option 3B – Signalization of the SR 503 (Lewis River Road)/E Scott Avenue and SR 503 (Lewis River Road)/N Goerig Street (restricted left-turn channelization is assumed) intersections. Provide an exclusive eastbound left-turn lane at the E Scott Avenue intersection with SR 503.

As shown in the table, operations would be improved with traffic signals at the SR 503 (Lewis River Road)/N Goerig Street intersection, and either a traffic signal or provision of a flying-T at the SR 503 (Lewis River Road)/E Scott Avenue intersection. Since Option 3B works slightly better (i.e., operations are LOS C at the SR 503 (Lewis River Road)/E Scott Avenue intersection) additional consideration was given to this scenario. Also shown in the table are traffic operations results for the minor intersections along SR 503 from Hillshire Drive to Evergreen Lane.

Table 4-8. 2025 PM Peak Hour Intersection Traffic Operations for SR 503 Options

		2025 PM Peak Hour with Comp Plan Plus Scenario			
Option/Intersection		Critical Movement	Average Delay (sec/veh.)	V/C Ratio	LOS
Option 1 – Major Intersection Improvements					
24	SR 503 (Lewis River Road) / N Goerig Street [1]	--	13.8	0.65	B
20	SR 503 (Lewis River Road) / E Scott Avenue	--	17.0	0.84	B
Option 3b – Major Intersection Improvements					
24	SR 503 (Lewis River Road) / N Goerig Street [2]	--	15.5	0.84	B
20	SR 503 (Lewis River Road) / E Scott Avenue [3]	--	22.9	0.83	C

Table 4-8. 2025 PM Peak Hour Intersection Traffic Operations for SR 503 Options Cont.

Option/Intersection		2025 PM Peak Hour with Comp Plan Plus Scenario			
		Critical Movement	Average Delay (sec/veh.)	V/C Ratio	LOS
Other Intersections					
21	SR 503 (Lewis River Road) / Hillshire Drive	EBL	9.2	0.09	A
		SB all	26.3	0.26	D
11	SR 503 (Lewis River Road) / Insel Road	EBL	8.2	0.05	A
		SB all	12.5	0.07	B
12	SR 503 (Lewis River Road) / Gun Club Road	EBL	8.3	0.13	A
		SB all	11.5	0.16	B
22	SR 503 (Lewis River Road)/ Fir Avenue	EBL	8.6	0.03	A
		SB all	11.7	0.02	B
23	SR 503 (Lewis River Road) / Evergreen Lane	EB all	19.5	0.04	C

Source: The Transpo Group, 2007.
1. Assumes protected/permissive phasing of the northbound left turn.
2. Restricts the north-to-northwest left turns and assumes stop control on the eastbound approach.
3. Assumes additional northbound left turns since N Goerig Street intersection would restrict left turns. Provides a northbound left turn lane with protected/permissive phasing, and a southbound right turn.

4.3.1.4 Sensitivity Analysis of Improvement Options along SR 503

There is potential for additional residential development on SR 503 east of the Urban Growth Area (UGA) which could increase traffic along SR 503. The City's traffic model showed that traffic volumes on SR 503 would increase by about 40 to 60 percent by 2025, or about 2 to 3 percent per year. An evaluation was conducted to determine if the proposed improvement options would continue to be sufficient if eastbound traffic increased due to potential additional development. The improvements were considered to be sufficient if the intersections met the LOS D standards. This evaluation showed that the maximum traffic increase the proposed improvements would support (and still maintain LOS D) would be approximately 0.1 to 0.5 percent increase per year in traffic or an increase of about 50 to 130 vehicles (for a maximum of about 1,150 to 1,200 vehicles) for the eastbound through movement; traffic increases beyond this level would require additional improvements along SR 503 to maintain LOS D.

It should be noted that the amount of traffic increase that would be accommodated varied for the improvement options. Option 1 would accommodate an increase of approximately 130 vehicles in the eastbound direction; however, with increases beyond this the southbound approach at the SR 503 (Lewis River Road)/Insel Road intersection would operate at LOS E and a traffic signal would be needed to provide operations that meet the LOS D standard. Option 3B would handle an increase of approximately 50 vehicles in the east/northbound direction before northbound queues at the SR 503 (Lewis River Road)/N Goerig Street intersection spilled back into the SR 503 (Lewis River Road)/N Goerig Street intersection to the south (i.e., about 1,000 feet) impacting operations at this intersection. Therefore, volume increases beyond about 50 vehicles for Option 3B would require additional capacity such as a second northbound through lane.

Table 4-9 shows a summary of the study intersection LOS for both options with the increased traffic volumes in the eastbound through direction.

Table 4-9 2025 PM Peak Hour Intersection Traffic Operations for SR 503 Options with Added Traffic Growth

		2025 PM Peak Hour with Comp Plan Plus Scenario					
		Option 1 [1]			Option 3B [2]		
Intersection		Average Delay (sec.)	V/C Ratio or WM [3]	LOS	Average Delay (sec.)	V/C Ratio or WM [3]	LOS
24	SR 503 @ Goerig Street	13.8	0.74	B	17.4	0.86	B
20	SR 503 @ Scott Avenue	21.9	0.90	C	24.0	0.86	C
21	SR 503 @ Hillshire Drive	33.5	SB	D	25.6	SB	D
11	SR 503 @ Insel Road	16.2	SB	C	15.9	SB	C
12	SR 503 @ Gun Club Rd	14.3	SB	B	14.1	SB	B
22	SR 503 @ Fir Avenue	11.5	SB	B	11.5	SB	B
23	SR 503 @ Evergreen Ln	17.1	SB	C	19.2	SB	C

Source: The Transpo Group, 2008.
1 Traffic volumes were increased by approximately 130 vehicles for the southbound through movement (inbound on SR 503).
2 Traffic volumes were increased by approximately 50 vehicles for the eastbound through movement.

As shown in the table, intersection operations for both options would be similar and meet the LOS D standard. However, Option 1 would accommodate a greater increase in traffic than Option 3B.

4.3.1.5 Traffic Operations with Other Study Area Intersection Improvement Options

Table 4-10 presents 2025 PM peak hour traffic operations analysis results at three study area intersections outside of the interchange areas or along SR 503 which would be adversely impacted by growth in traffic volumes in the study area. Each of these locations was identified in the Future Conditions Technical Memorandum (November 2007) as needed improvement to operate at acceptable levels of service. Detailed level of service worksheets for these improvements are presented in Appendix I.

Improvements identified for these intersections include the following:

- Old Pacific Highway at Green Mountain Road: add southbound left turn lane and signalize intersection
- Old Pacific Highway at E. Scott Avenue: add southbound left turn lane, signalize and reconfigure to provide 90-degree intersection on E Scott Avenue leg.
- Davidson Avenue at 5th Street: restrict on-street parking to add westbound left turn lane and signalize intersection.

Table 4-10. 2025 PM Peak Hour Intersection Traffic Operations for Other Study Area Locations without Scott Avenue Crossing

		Future (2025) Comp Plan Plus – without Improvements			Future (2025) Comp Plan Plus – Build Options		
Intersection		Control Delay (sec/vehicle)	V/C Ratio	LOS	Control Delay (sec/vehicle)	V/C Ratio	LOS
5	Old Pacific Hwy @ Green Mountain Road (add SB left & signal)	**>50.0**	**>1.00**	**F**	7.7	0.56	A
10	Old Pacific Highway @ E Scott Avenue (add SB left & signal)	**61.4**	**>1.00**	**F**	7.7	0.55	A
15	Davidson Avenue @ 5th Street (northbound movement) (add WB left &signal)	**51.4**	**0.81**	**F**	9.0	0.61	A

Table 4-11 presents a summary of traffic back-ups anticipated at each intersection with the recommended improvements based on a 95 percent confidence interval. As indicated in the table, all 2025 PM peak hour traffic queues are expected to be accommodated within the available storage provided by the improvement with one exception. The added westbound left turn lane would like experience periodic traffic queues during the PM peak hour. However, it should be noted that this impact also assumes that, under the Comp Plan Plus forecast scenario, most of the new residential development in the city would occur to the southwest of the existing downtown. A more uniform or different distribution of traffic would likely reduce this projected queuing impact.

Table 4-11. 2025 PM Peak Hour Traffic Queuing Summary for Other Study Area Locations without Scott Avenue Crossing

		Future (2025) Comp Plan Plus – Build Options		
Intersection		**Movement**	**Available Storage (ft)**	**Queue Length (ft.)**
5	Old Pacific Hwy @ Green Mountain Road	WB Left	100 ft	80 ft
		SB Thru	>500 ft	210 ft
		SB Left	100 ft	50 ft
10	E Scott Avenue @ Old Pacific Highway	EB	>500 ft	80 ft
		WB	100 ft	60 ft
		NB	>500 ft	110 ft
		SB Thru	>500 ft	170 ft
		SB Right	150 ft	120 ft
15	Davidson Avenue @ 5th Street	EB	200 ft	60 ft
		WB Thru	200 ft	30 ft
		WB Left	75 ft	**250 ft**
		NB	200 ft	90 ft
		SB	200 ft	40 ft

Note 1: NB means northbound, SB means southbound, EB means eastbound, and WB means westbound.
Note 2: **Bold** type indicates locations where available vehicle storage space would be exceeded.

4.3.2 2025 Intersection Operations for Improvement Options with the Scott Avenue Crossing

This section summarizes the results of traffic operations analysis for various improvement options assuming that the Scott Avenue crossing of I-5 and the BNSF railroad tracks is constructed. This condition would provide a more balanced distribution of traffic crossing I-5 and the BNSF railroad by diverting approximately 44 percent of east/west PM peak hour traffic from Dike Road at I-5 to the Scott Avenue crossing and approximately 30 percent from SR 503 at I-5.

The analysis presented in this section focuses on improvement needs at several intersections within the larger including the I-5/SR 503 interchange and vicinity, intersections in various other parts of the city that require improvement based on 2025 PM peak hour traffic volume projections and no-build operations, and the interchange of Scott Avenue with I-5 to/from the north which offers greater freeway connectivity with the proposed crossing in place.

4.3.2.1 Traffic Operations at Key Intersections with Scott Avenue Crossing

Table 4-12 presents 2025 PM peak hour traffic operations analysis results at the key study area intersections for the option with the Scott Avenue crossing in place. Data in this table includes LOS results, average delay per vehicle, volume-to-capacity (v/c) ratios, and critical movements where appropriate. Detailed level of service worksheets for these improvement options are presented in Appendix J.

The improvement option for the interchange of I-5 with SR 503 that has been evaluated in this scenario assumes that the Scott Avenue crossing would be in place. Thus, the traffic passing through the SR 503 interchange area would be significantly reduced over conditions without the crossing, resulting in a reduced need for major interchange improvements. This option is illustrated in Figure D-6A of Appendix D.

As indicated in the table, this option would provide acceptable levels of service at the major intersections in the interchange vicinity. However, congestion would remain relatively high at the intersection of the I-5 northbound off-ramp/Atlantic Avenue with SR 503. This would result in some queue spillback into adjacent intersections as shown in Table 4-13.

Table 4-12. 2025 PM Peak Hour Intersection Traffic Operations Summary with Scott Avenue Crossing

		Future (2025) Comp Plan Plus Scenario with Scott but without Improvements			Future (2025) Comp Plan Plus Scenario with Scott Crossing with Improvements		
No.	**Signalized Intersections**	**Control Delay (secs/vehicle)**	**V/C Ratio**	**LOS**	**Control Delay (secs/vehicle)**	**V/C Ratio**	**LOS**
17	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	36.3	0.86	D	23.7	0.87	C
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Rd)	**>100.0**	**1.18**	**F**	53.9	1.15	D
19	SR 503 (Lewis River Road) @ CC Street	**80.5**	**0.77**	**F**	--	--	--
	SR 503 (Lewis River Road) @ A Street	**--**	**--**	**--**	29.0	0.70	C
No.	**Unsignalized Intersections**	**Control Delay (sec./veh) (1)**	**V/C Ratio**	**LOS**	**Control Delay (secs./vehicle)**	**V/C Ratio**	**LOS**
5	Old Pacific Hwy @ Green Mountain Road	22.4	0.59	C	--	--	--
6	Schurman Way @ Guild Road	13.2	0.24	B	--	--	--
7	W Scott Avenue @ N Pekin Road	17.4	0.38	B	--	--	--
8	W Scott Avenue @ Pacific Avenue/I-5	10.3	0.04	B	31.3	0.86	C
9	E Scott Avenue @ Atlantic Avenue/I-5	13.8	0.32	B	22.4	0.72	C
10	E Scott Avenue @ Old Pacific Highway (4)	**>50.0**	**>1.00**	**F**	10.2	0.69	B (6)
13	SR 503 @ Goerig Street (westerly) (5)	**>50.0**	**>1.00**	**F**	15.9	0.02	C
14	Caples Road @ N Pekin Road	11.0	0.09	B	--	--	--
15	Davidson Avenue @ 5th Street	16.1 (2) 16.6 (3)	0.36 0.16	C C	--	--	--
16	Buckeye Street @ Goerig Street	**>50.0**	**>1.00**	**F**	12.3	0.63	B (6)

Note: LOS means level of service, V/C means volume-to-capacity ratio, NB means northbound direction of approach to an intersection, SB means southbound, EB means eastbound, and WB means westbound.
(1) Worst Movement
(2) Northbound movement
(3) Southbound movement
(4) Improvements include signalization with the addition of an eastbound left turn lane, a westbound right turn lane, and a southbound right turn lane.
(5) Side street traffic is restricted to Right In/Right Out movements.
(6) Intersection signalized.

Table 4-13. 2025 PM Peak Hour Traffic Queuing Summary with Scott Avenue Crossing

Intersection		Future (2025) Comp Plan Plus – Build Options		
		Movement	Available Storage (ft)	Queue Length (ft.)
16	Buckeye Street @ Goerig Street	NB	200 ft	**1,370 ft**
		SB	300 ft	280 ft
		EB	200 ft	**510 ft**
		WB	>1,000 ft	870 ft
17	I-5 SB On-Ramp @ SR 503 (Lewis River Rd)	EB Thru	300 ft	290 ft
		EB Thru/Left	300 ft	290 ft
		WB Thru	420 ft	430 ft
		WB Left	200 ft	**460 ft**
		SB Thru/Left	>1,000 ft	660 ft
		SB Left	100 ft	**580 ft**
18	I-5 NB Off-Ramp @ SR 503 (Lewis River Rd)	EB Thru	400 ft	**560 ft**
		EB Left	200 ft	**600 ft**
		WB Thru	300 ft	**530 ft**
		SB Left	50 ft	**480 ft**
		SB Right	>1,000 ft	320 ft
		NB Thru/Left	1.200 ft	810 ft
		NB Right	250 ft	**960 ft**
	SR 503 (Lewis River Road) @ A Street	EB Thru	400 ft	**640 ft**
		EB Thru/Right	375 ft	**510 ft**
		WB Thru	>500 ft	370 ft
		WB Left	400 ft	400 ft
		NB Left	540 ft	540 ft
		NB Right	250 ft	250 ft
8	W Scott Avenue @ Pacific Avenue/I-5	WB Left	200 ft	130 ft
		WB Thru	200 ft	140 ft
		SB Left	>1,000 ft	730 ft
		SB Thru/Right	>1,000 ft	670 ft
9	E Scott Avenue @ Atlantic Avenue/I-5	NB Thru/Right	>500 ft	120 ft
		EB Left	200 ft	120 ft
		EB Thru	200 ft	200 ft
		EB Right	200 ft	120 ft
		WB Left	150 ft	80 ft
		WB Thru/Right	>500 ft	110 ft
10	E Scott Avenue @ Old Pacific Highway	EB	>500 ft	80 ft
		WB	100 ft	60 ft
		NB	>500 ft	110 ft
		SB Thru	>500 ft	170 ft

The reconfigured intersections of Scott Avenue with the I-5 ramps to/from the north would operate at acceptable levels of service with the addition of the crossing improvement. Modification of the southbound off-ramp will be necessary to provide for two lanes after exiting from I-5 to accommodate expected traffic volumes. Recommended improvements are illustrated in Appendix D, Figure D-7C.

The proposed improvement at the intersections of Scott Avenue with Old Pacific Highway is illustrated in Appendix D, Figure D-7D and includes the addition of a southbound left turn

lane, signalization and reconfiguration of the east (Scott Avenue) leg of the intersection to accommodate at 90-degree approach. This improvement would provide acceptable traffic operations with minimal traffic queues.

The proposed improvement at the intersection of SR 503 at Goerig Street (westerly location) would restrict side street traffic movements to right-in/right-out only. This would provide an acceptable level of service.

4.4 ENVIRONMENTAL ISSUES

4.4.1 Environmental Resource Evaluation

This section identifies the specific impacts related to the various improvement options under consideration for the major subareas within the Woodland study area. There are a few general considerations that apply to all transportation system improvement areas including increased impervious surface areas, additional hazardous materials reconnaissance, and compliance with SEPA requirements which will be discussed for the overall project here.

To comply with stormwater management water quality and quantity standards for increased stormwater from increased impervious surfaces, the project will be required to adhere to the City of Woodland Critical Areas Ordinance requirements for location of stormwater facilities. These facilities cannot be located within wetlands, but are permittable within portions of wetland buffer areas (Woodland Municipal Code 15.08.400.L.4). Additionally the project must obtain a Hydraulic Project Approval (HPA) from the Washington Department of Wildlife (WDFW), a joint 404/401 permit from the Corps and DOE, and a National Pollution Discharge Elimination System (NPDES) permit from the DOE.

The hazardous materials investigation completed for the *Woodland TISP Existing Conditions Technical Memorandum* (August 2007) was limited to a regulatory database search for the potentially affected project areas. Because the regulatory databases may not include all hazardous materials sites, and may not provide highly accurate location information, a site reconnaissance of the right of way expansion areas and additional file review for hazardous materials sites is recommended for all improvement options.

All project alternatives will need to be approved by the DOE through a SEPA checklist.

4.4.2 I-5/Dike Road Area Improvement Options

Potential environmental concerns for the Dike Road improvement options are minor and are related to wetlands and hazardous materials. The NWI mapped wetlands, to the south and north of the Dike Road interchange, are known to flood during heavy rain events due to drainage from slopes to the east and northeast. These areas are not within the FEMA FIRM mapped 100-year floodplain, but have caused flooding issues in the past. Both Option 4B and Option 5 would require the same extent of minimal right of way expansion towards the NWI mapped wetland area to the north of Dike Road. The wetland will need to be delineated to further evaluate whether direct impacts will occur to wetland areas, and a Critical Areas Permit, and a Joint Aquatic Resources Permit Application (JARPA) to DOE and Corps may be required to conduct expand the roadway at this location.

Additionally, future drainage improvements are likely along the northbound I-5 lanes and the recommended Dike Road improvements will need to accommodate the flooding concern and the future drainage improvements.

There are also unmapped potential wetland areas surrounding the I-5 Southbound on/off ramp intersection with Dike Road as identified in a reconnaissance level survey of the area and review of aerial photographs. Because the assumed existing condition of this intersection is a

constructed round-about as indicated by preliminary plans related to the Walmart development, these potential wetlands will have already been disturbed to some extent prior to the Dike Road improvements. However, any construction related to the chosen Dike Road alternative options at this intersection may further impact these areas. Site evaluation, and, if deemed appropriate, wetland delineations should be performed on the land surrounding this intersection. If jurisdictional wetlands are present, a Critical Areas Permit and JARPA may be required.

The initial environmental resources review of the Dike Road Alternative vicinity indicated a potential hazardous materials site. Site 54, from Table 3-3 in the *Woodland TSIP Existing Conditions Technical Memorandum* (August 2007), is located at the east end of the Dike Road project area and has had contamination confirmed in the past. As currently proposed, no right of way would be required to be purchased from this site under Option 4B or Option 5, therefore, no further environmental investigation at Site 54 is required. However, there is a property to the west of Site 54 that contains wetlands and a stream channel, and there is potential that any hazardous materials contaminating the ground at Site 54 could have migrated to the vacant, wetland and riparian site. Right of way is required from this site, so further hazardous materials investigation is recommended including a site visit and other inquiries as appropriate for due diligence.

Other areas of proposed improvements for the Dike Road Alternative options will require right of way expansion, but do not appear to pose any other environmental concerns.

4.4.3 I-5/SR-503 Interchange Area Improvement Options

There are three distinct alternatives for the I-5, SR-503 Crossing area, Options 2B, 3B, and 5. There are no wetlands indicated near the project alignments. However, the area south of SR 503 (Lewis River Road) and east of Atlantic Avenue is within the 100-year floodplain and some project components of all three options may be affected by the floodplain. A City of Woodland Floodplain Permit will likely be required.

There are two hazardous materials sites on the eastern end of the crossing options. The project option alignments indicate that Options 3B and 5 will require some extent of right of way to be purchased from these sites, so if either of these options were chosen, further site investigation would be necessary. Both Hazardous Materials Sites 3 and 73, as shown on Table 3-3 in the *Woodland TISP Existing Conditions Technical Memorandum* (August 2007), are gas stations. Option 3B would affect a very small portion of both sites, while Option 5 would only affect Site 3, and the area needed is substantial and would come close to existing structures. Under either option, a full Phase I Environmental Assessment in conformance with ASTM 1527-05 would be needed for purchase of any right of way at these sites.

4.4.4 Scott Avenue Crossing

Four improvement options were considered in the final evaluation for the Scott Avenue crossing of I-5 and the BNSF railroad. Two options for the alignment of Scott Avenue itself, and two for the realignment of N Pekin Road to intercept Scott. Either Pekin Road option can be used with either Scott Avenue option.

The Scott Avenue Options 4D and 4E (see Figures D-7A through D-8D in Appendix D) have very similar right of way needs because their differences are vertical rather than horizontal. Thus, their potential environmental impact concerns are identical. From Pekin Road to approximately Downriver Drive some right of way acquisition would be needed, however no natural resources are affected. Hazardous Materials Site 26 as shown in Table 3-3 in the *Woodland TISP Existing Conditions Technical Memorandum* (August 2007) has documented contamination and is located along W Scott Avenue. At this time, the location information for

this site is insufficient to determine if right of way requirements are needed on Site 26. If it is later determined that no right of way is needed, no further environmental investigation would be required. If right of way is required, then a full Phase I Environmental Assessment in conformance with ASTM 1527-05 would be needed.

Between Downriver Drive and approximately Pacific Avenue Hazardous Materials Site 32 as shown on Table 3-3 in the *Woodland TISP Existing Conditions Technical Memorandum* (August 2007) has an indication of potential contamination. At this time, the location information for this site is insufficient to determine if right of way requirements are needed on Site 32. If it is later determined that no right of way is needed, no further environmental investigation would be required. If right of way is required, then a full Phase I Environmental Assessment in conformance with ASTM 1527-05 would be needed. No other resources are affected by this area. Finally, for the section of the Scott Avenue between Pacific Avenue and North Goerig Street, there are right of way needs for expansion, but there are no identified environmental resources that will be affected.

Pekin Road Option 1 (see Figure D-9 in Appendix D) requires new right of way along Pekin Road, Scott Avenue and the new portion of Pekin Road. However, there are no environmental resources identified in any of the required right of way areas. Aside from the recommended site reconnaissance for hazardous materials for all right of way purchase areas, no additional permits or reviews are recommended.

Pekin Road Option 2 (see Figure D-10 in Appendix D) also requires new right of way along both Pekin Road and Scott Avenue and also creates a new road with entirely new right of way. No environmental resources are associated with the right of way expansion areas. The only environmental resource identified near the entirely new Pekin Road right of way is an NWI mapped wetland to the west of the new route. A site evaluation should be conducted to determine how close the new alignment will come to the mapped wetland, and a formal wetland delineation and Critical Areas Permit may be required. Additionally, a JARPA through DOE and the Corps would be required if any impacts would occur to the wetland.

4.4.5 East SR-503 East Improvement Options

There are two options for the proposed improvement area of SR-503 to the west of Hillshire Drive and south through the intersection with Goerig Street (see Figures D-11A and D-11B in Appendix D). Both options will likely have some direct impact on hazardous materials Site 31 as shows on Table 3-3 in the existing conditions technical memorandum. This site has documented contamination, and would require a full Phase I Environmental Assessment in conformance with ASTM 1527-05 for purchase of any right of way. Option 1 requires the least right of way where the need is limited to the far southeast corner of the property, while Option 3b requires a sliver of right of way along nearly the full extent of the eastern property line along SR-503.

There are also NWI mapped wetlands identified between the Lewis River and SR-503. Neither option will have direct impacts to the identified wetlands, but construction may occur within a City of Woodland Critical Areas Ordinance wetland buffer area which may require a Critical Areas Permit. Wetland delineation may be required. In addition, there is a retaining wall along the edge of the roadway adjacent to the wetlands and the Lewis River. Roadway improvements will need to be limited such that no disturbance occurs to this wall.

Only one option is proposed for improvements to SR-503 from Hillshire Drive east to Evergreen Lane (see Figures D-11C through D-11E in Appendix D). The improvements would require widening SR-503 with right of way needs on both sides of the roadway for nearly the entire length of the improvement area, except where recent developments have already provided sidewalks and wider roadways, primarily on the north side of SR-503

between Insel Road and Gun Club Road. There are no NWI mapped or potential wetlands identified in the areas to be disturbed.

One identified hazardous materials site, Site 67 from Table 3-3 in the *Woodland TISP Existing Conditions Technical Memorandum* (August 2007), is located immediately south of SR-503 within the improvement area. Although right of way is likely to be purchased from the identified hazardous materials site, at this time no further environmental investigation is required because the site does not have documented contamination.

The full extent of the area proposed for improvements to SR-503 is within or adjacent to the FEMA FIRM mapped 100-year floodplain. A Development Permit from the City of Woodland will be required for work within the 100-year floodplain.

4.5 COST ESTIMATES

Preliminary costs for each alternative were prepared in 2008 dollars and were developed using unit cost information from numerous sources. These sources included WSDOT historical unit cost data, WSDOT Planning Level Cost Estimation (PLCE) software, and input from both Parametrix and WSDOT personnel with similar project and construction cost estimating experience. Further guidance was found in documents provided to Parametrix by WSDOT including, "Cost Estimating Guidance for WSDOT Projects" (November 2007), "WSDOT Market Analysis" (March 2008), and "WSDOT Highway Construction Costs" (June 2008). Property values for right-of-way acquisition costs were determined from the Cowlitz County Assessor property parcel data available on the Cowlitz County Website.

Estimated costs for each major alternative are presented in Table 4-14. Costs were rounded to the nearest million dollars for purposes of discussion in this report. Details and assumptions related to the cost estimates for the refined improvement options are included in Appendix K.

Table 4-14. Project Improvement Options Preliminary Cost Estimates

Project Name	Location/Limits	Description	Cost Estimate (2008 $)
I-5/Dike Road Interchange Vicinity Improvement Options			
I-5 at Dike Road	Schurman Way to northbound ramps	• Construct single lane roundabouts at ramp termini • Option 3B - Construct single lane roundabout at Schurman	Wal-Mart mitigation $2,400,000
I-5 at Dike Road	Schurman Way to northbound ramps	• Option 4B: Widen Dike Road for left turn lanes, signalize ramps and Schurman	$33,000,000
I-5 at Dike Road	Schurman Way to northbound ramps	• Option 5: Widen Dike Road for left turn lanes, signalize ramps, partial signal at Schurman	$34,000,000
I-5/SR 503 Interchange Vicinity Improvement Options			
I-5 at SR 503	Buckeye/Goerig to SR 503/CC Street	• Option 2B: Construct multi-lane roundabouts, realign Lakeshore Road, restricted stop control at Buckeye	$4,000,000
I-5 at SR 503	Buckeye/Goerig to SR 503/A Street	• Option 3B: Widen SR 503 through interchange area, add signals at Buckeye	$30,000,000
I-5 at SR 503	Buckeye/Goerig to SR 503/A Street	• Option 5: Construct one-way couplet with signalized intersections	$21,000,000
I-5 at SR 503	Buckeye/Goerig to SR 503/A Street	• Option 6: Added turn lanes and selected widening with coupled with Scott Crossing in place	$8,000,000
Scott Avenue Crossing			
Scott Avenue	Schurman to Old Pacific Highway	• Option 4D: Construct overcrossing of railroad and undercrossing of I-5 (raise I-5 profile), signalize ramp termini on Scott, at-grade intersection with Down River	$47,000,000
Scott Avenue	Schurman to Old Pacific Highway	• Option 4E: Construct overcrossing of railroad and I-5, signalize interchange ramp termini on Scott, at-grade intersection with Down River	$49,000,000
Scott Avenue at Pekin Road	Relocation of existing connection	• Option 1: Realign N Pekin to connect with Scott Avenue west of existing intersection to meet road grade • Option 2: Grade-separate Scott Avenue and N Pekin, connect N Pekin to Schurman via Port Way	$7,000,000 $7,000,000
SR-503	Goerig Street to Evergreen Lane	• Widen to 3-lane cross-section, install bicycle and pedestrian facilities	$6,000,000
	SR 503 at Goerig and Scott	• Option 1: Signalize both intersections, smooth curve at Scott and add left turn channelization on SR 503 • Option 3B: Signalize Scott, smooth curve and add left turn lanes on SR 503, restrict lefts at Goerig	$5,000,000 $4,000,000
	Hillshire Drive to Gun Club Road	• Interim improvement – 2-way left turn lane and shoulders	$800,000