KITTELSON & ASSOCIATES

851 SW 6TH AVENUE, SUITE 600
PORTLAND, OR 97024
P 503.228.5320 F 503.273.8169

TECHNICAL MEMORANDUM

Date: November 6, 2020 Project #: 23618

To: Tracy Coleman (City of Woodland)

Cc: Washington State Department of Transportation
Cowlitz-Wahkiakum Council of Governments

From: Anthony Yi, PE, Caleb Cox, Chelsea Farnsworth, and Ali Razmpa (Kittelson)

Project: I-5 at SR 503 Interchange Improvements

Subject: Exit 21 Transportation Assessment (Phase 1)

INTRODUCTION

The Interstate 5 (I-5) at SR 503 interchange (Exit 21) improvement project looks to build upon the momentum generated by the City of Woodland and greater community to improve the transportation system within the Exit 21 interchange area to address current traffic operation needs and accommodate both near and long-term growth opportunities. This overall project will not only improve east-west mobility for the City, it will also enhance the vital linkage between the community and I-5. In addition to improving circulation and access for various modes, reducing congestion and greenhouse gas emissions, it will help achieve the strategies outlined in the City's Comprehensive Plan and Transportation Infrastructure Strategic Plan.

As the City leads the charge with improving operations and safety at one of the City's major entry and exist points to I-5, this initial project phase (Phase 1) will help to:

- Gain a comprehensive understanding of the key transportation issues within the interchange study area (particularly with the future residential growth and recent annexation of 460 acres).
- Develop a range of improvement concepts to be taken through a comprehensive public and stakeholder engagement process, that follows WSDOT's Practical Solutions process.
- Set the stage for a preferred concept that can be taken into final design (Phase 2) and construction (Phase 3).

This Phase 1 document summarizes the existing year 2019 and projected year 2040 traffic conditions at the I-5/SR 503 interchange (Exit 21) and presents the improvement concepts that have been developed and discussed with stakeholders and the Woodland community. This memorandum is organized into the following categories:

- Background and Project Needs
- Scope of the Study and Analysis Methods
- Existing Year 2019 Traffic Conditions
- Future Year 2040 No-Build Traffic Conditions
- Alternatives Development and Evaluation
- Summary and Conclusion

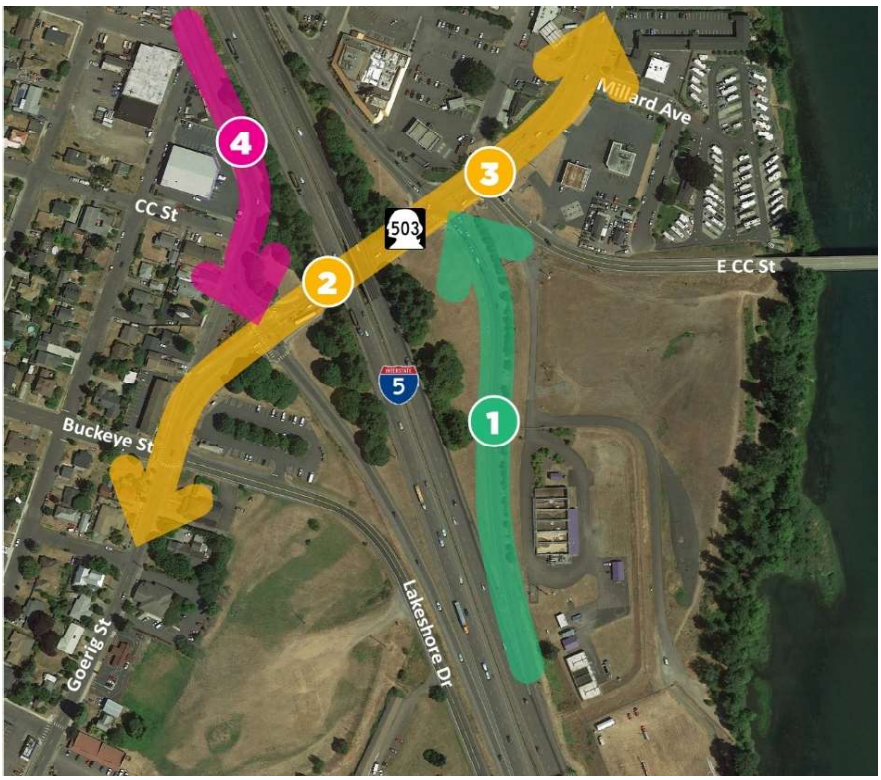
BACKGROUND AND PROJECT NEEDS

Safe and efficient traffic operations throughout the I-5/SR 503 interchange area is vital to the City and surrounding communities as it serves as one of the major connection points to I-5, while SR 503 provides a major linkage between the City's west and east sides. The City of Woodland is projecting their population to grow by nearly 50% in the next 20 years, and much of that growth will be focused in the southern region with the potential for up to 2,000 new homes being constructed in the next 5 to 10 years. In addition, 460 acres of agricultural land has recently been annexed into the City that has been zoned industrial. This growth is expected to put significant stress on the already struggling interchange area at Exit 21, so the City proposed to conduct a traffic operations analysis and explore design alternatives to aid in improving travel for all modes and upgrading infrastructure to meet future transportation demands. Past studies and observed experiences highlight the following primary issues in the study area:

- SR 503/Atlantic Avenue/I-5 Off-ramp – Overall intersection capacity issues for vehicular traffic and queues in the northbound direction that can spill back onto I-5.
- SR 503/Pacific Avenue/I-5 On-ramp – Overall intersection capacity issues for vehicular traffic and long vehicle queueing in the southbound direction.
- The existing signalized cluster interaction between the SR 503/Atlantic Ave/I-5 Off-ramp and SR503/E CC Street intersections causes extended delay and overall intersection inefficiencies.

Figure 1 illustrates the study area and key issues.

Figure 1 - Study Area and Key Issues



KEY PROJECT ISSUES

1. **BACKUPS AT THE EXIT 21 NORTHBOUND OFF-RAMP**, particularly during the weekday PM rush hour, at times spilling back to the I-5 mainline.
2. **HEAVY CONGESTION ON SR 503 BETWEEN LAKESHORE DR & MILLARD AVE** causes drivers to wait through multiple signal cycles and worsens traffic at the Goerig/Buckeye-Lakeshore intersection.
3. **THE MULTIMODAL ENVIRONMENT:** Facilities need to be added in the interchange area and on local streets to better accommodate pedestrians and bicyclists.
4. **CONGESTION AND BACKUPS (>900 FEET) AT THE SOUTHBOUND APPROACH TO THE SR 503/PACIFIC AVE INTERSECTION** causes drivers to wait through multiple signal cycles and worsens traffic at the adjacent side street intersections.

SCOPE OF THE STUDY AND ANALYSIS METHODS

The scope of this traffic assessment includes the evaluation of existing and future traffic operations at the following study locations.

- Goerig Street/Bozarth Avenue/Park Road
- Goerig Street/Buckeye Street/Lakeshore Drive
- Goerig Street/Lewis River Road
- Goerig Street/Pacific Avenue
- Pacific Avenue/CC Street
- SR 503/Pacific Avenue/I-5 SB On-ramp
- SR 503/Atlantic Avenue/I-5 NB Off-ramp
- SR 503/E CC Street
- SR 503/Millard Avenue

The transportation analysis focuses on addressing capacity and safety needs at the study intersections and provides recommendations to be carried forward in the development and design of the I-5/SR 503 interchange. This technical memorandum includes the following key items:

- Existing year 2019 traffic operations, geometric conditions, and crash history at the study locations;
- Development of future year 2040 traffic volumes using historical traffic counts, regional growth, and travel demand model outputs;
- Projected future year 2040 traffic operations;
- Improvement concepts and evaluation; and,
- Recommendations for the study locations to inform the design process.

ANALYSIS METHODOLOGY

The intersection analyses described in this memorandum were performed in accordance with the procedures stated in the *2000 Highway Capacity Manual* (HCM) and *Highway Capacity Manual* (HCM) *6th Edition* (Reference 1 and 2). Operational and queueing analyses were performed using the Synchro 10 traffic analysis software for signalized intersections, and SIDRA Intersection 8 software for roundabout intersections.

Intersection Performance Measures

Several performance measures are used to assess the overall quality of the travel experience through an intersection or roadway segment as it is perceived by the traveler. A brief description of each performance measure is provided below.

Level of service (LOS) has been the most used performance measure. LOS uses an "A" to "F" ranking based on the average control delay experienced by motorists. LOS "A" conditions show very low vehicle delay times (10 seconds or less), while LOS "F" conditions have high delay times (over 80 seconds per vehicle at a signalized intersection.

Level of service for signalized intersections is based on a weighted average per-vehicle control delay for the intersection while the analyses for two-way stop-controlled intersections are based on the delay at minor approaches and the major street left-turn movements. No delay is assumed on the major street through movements; levels of service and volume-to-capacity ratios are only calculated for each minor street lane.

Volume-to-capacity ratio (V/C) compares the volume of traffic to the theoretical capacity of the facility to accommodate traffic. A V/C Ratio of 1.0 indicates an intersection is operating at capacity. A V/C ratio over 1.0 indicates the intersection's capacity is exceeded, meaning that the vehicle may have to wait more than one signal cycle length at a signalized intersection before moving through the intersection.

WSDOT Operating Standards

WSDOT provides LOS standards within the Washington Geospatial Open Data Portal. Per WSDOT standards, a LOS of D or better is the acceptable operating standard for urban highway routes of statewide and non-statewide significance.

City of Woodland Operating Standards

The City of Woodland's LOS standards are defined in the Woodland Comprehensive Plan 2016-2036, page T-47, policy T 1.2, as follows:

> Establish LOS C or better as the desired standard for the I-5 mainline within the city, consistent with the regional CWCOG/SWRTPO standard. Establish a LOS standard of LOS D or better for arterial state highways (SR 503), major arterials, and minor arterials. Establish acceptable levels of traffic on collector roads and local streets through street design standards.

Summary of Applicable Agency Operating Standards

Table 1 summarizes the operation standards and jurisdiction administering each study intersection.

Table 1 – Intersection Operations Standards

Intersection	Jurisdiction	LOS Standard
Goerig St/Park Rd/Bozarth Ave	City of Woodland	N/A[1]
Goerig St/Lakeshore Dr/Buckeye St	City of Woodland	N/A[1]
Goerig St/Lewis River Rd	City of Woodland	D
Goerig St/Pacific Ave	City of Woodland	D
Pacific Ave/CC St	City of Woodland	D
SR 503/Lewis River Rd/Pacific Ave/I-5 SB On-ramp	WSDOT	D
SR 503/Atlantic Ave/I-5 NB Off-ramp	WSDOT	D
SR 503/E CC St	WSDOT	D
SR 503/Millard Ave	WSDOT	D

EXISTING YEAR 2019 TRAFFIC CONDITIONS

The existing conditions analysis identifies the current traffic operations, traffic control devices, and geometric characteristics of the transportation facilities within the study area. This section contains the existing corridor/intersection lane configurations, traffic control devices, pedestrian and bicycle facilities, transit service, geometric features, and adjacent land uses.

SITE CONDITIONS AND ADJACENT LAND USES

Land uses in the study area are zoned as a combination of highway commercial, high density residential and central business. SR 503 serves the commercial district and provides east-west connectivity across the city.

ROADWAY FACILITIES

Table 2 summarizes the characteristics of the existing transportation facilities in the study area.

Table 2 - Existing Transportation Facilities and Roadways in the Study Area

Roadway	Functional Classification[1]	Number of Lanes	Posted Speed (mph[2])	Sidewalks	Bicycle Lanes	On-Street Parking
I-5	Interstate	6 lanes	70	No	No	No
SR 503 (Lewis River Road)	Minor Arterial	5 lanes	30	Yes	No	No
Millard Avenue	Local Access	2 lanes	25	Yes	No	Yes
E CC Street	Minor Arterial	2 lanes	25	Yes	No	No
Atlantic Avenue	Minor Arterial	2 lanes	25	Yes	No	No
Pacific Avenue	Minor Arterial	2 lanes	25	Yes	No	No
CC Street	Local Access	2 lanes	25	Yes	No	Yes
Goerig Street	Major Collector	2 lanes	25	Yes	No	No
Buckeye Street/Lakeshore Drive	Major Collector	2 lanes	25	Yes	No	Yes
Bozarth Ave/Park Rd	Major Collector/Local Access	2 lanes	25	Yes	No	Yes

[1]*Functional Classification based on the City of Woodland's Transportation Plan (Reference 3)*
[2]*mph = miles per hour*

EXISTING TRAFFIC CONDITIONS

Turning Movement Volumes

Intersection turning movement counts were collected at the study intersections on Tuesday, May 21, 2019 during the morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak periods. The traffic data

was analyzed to determine intersection LOS, control delay, and V/C ratio. Based on the traffic counts, the peak hours of traffic occurred between 7:55 to 8:55 AM and 4:00 to 5:00 PM, respectively.

Figure 2 illustrates the existing lane configuration and Figures 3 and 4 illustrate the turning movement volumes during the weekday AM and weekday PM peak hours, respectively. *Attachment "A" contains the turning movement count data for the study intersections.*

Year 2019 Traffic Operations

An operational analysis was performed for the two time periods using the volumes shown in Figures 3 and 4. Table summarizes the existing year 2019 traffic operations at the study intersections during the weekday AM and weekday PM peak hours. The SR 503/Atlantic Avenue/I-5 NB Off-ramp intersection and the SR 503/E CC Street intersection are separated by approximately 100 feet and operated by a single signal controller. The City and project team noted in field observations that this causes the two intersections to operate like a single, five-leg intersection. Though, the operational assessment for the existing and no-build conditions includes delay and LOS calculations assuming they are separate intersections. *Attachment "B" contains the 2019 existing traffic operations worksheets.*

Table 3 - Year 2018 Existing Traffic Operations Summary

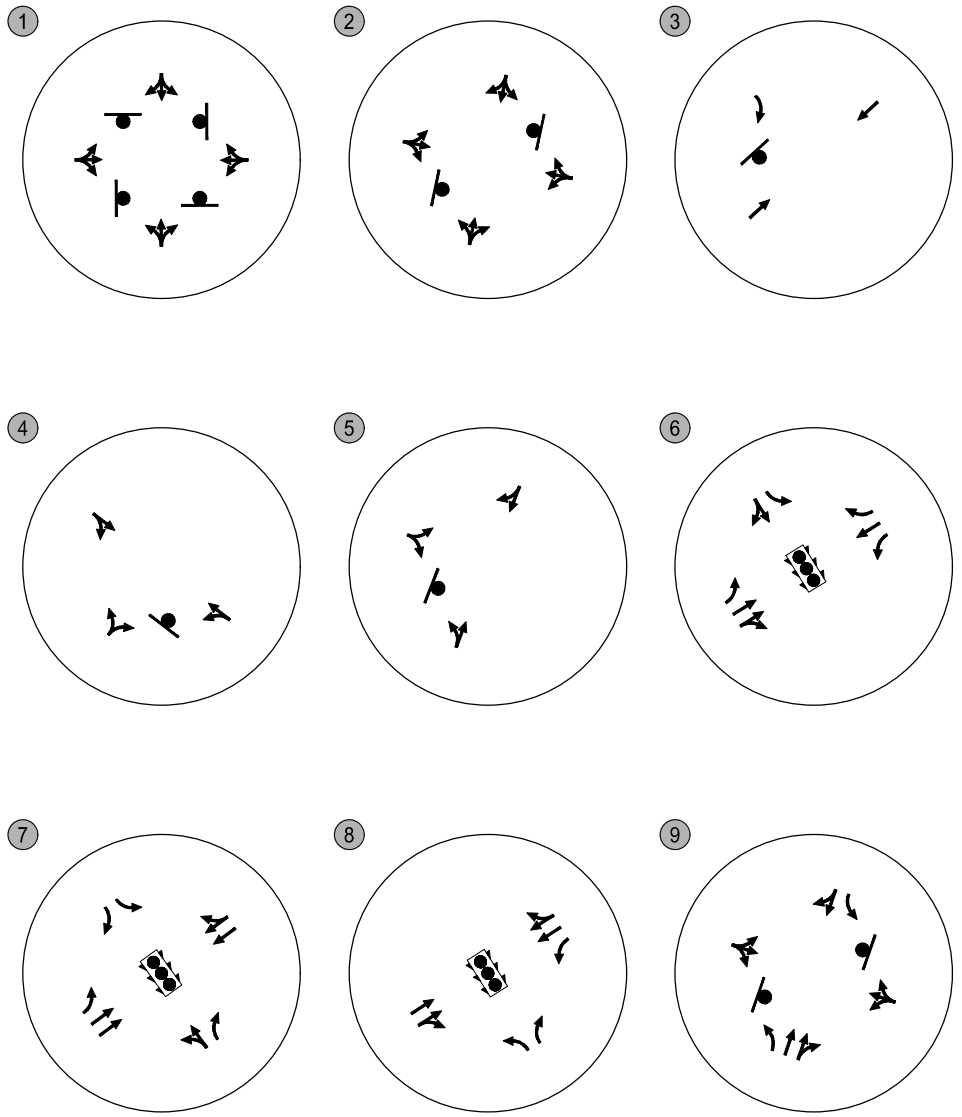
Int. No.	Intersection	Control Type	Jurisdiction	LOS	Weekday AM Peak Hour			Weekday PM Peak Hour		
					Delay (s/veh)[1]	LOS[2]	V/C[3]	Delay (s/veh)[1]	LOS[2]	V/C[3]
1	Goerig St/Park Rd/Bozarth Ave	AWSC	City of Woodland	N/A[4]	11.9	B	0.53	9.7	A	0.34
2	Goerig St/Lakeshore Dr/Buckeye St	TWSC	City of Woodland	N/A[4]	52.3	F	0.48	71.2	F	0.68
3	Goerig St/Lewis River Rd	TWSC	City of Woodland	D	15.8	C	0.28	11.5	B	0.10
4	Goerig St/Pacific Ave	TWSC	City of Woodland	D	8.4	A	0.01	8.6	A	0.01
5	Pacific Ave/CC St	TWSC	City of Woodland	D	11.6	B	0.08	12.2	B	0.06
6	SR 503/Lewis River Rd/Pacific Ave/I-5 SB On-ramp	Signal	WSDOT	D	18.4	B	0.81	24.2	C	0.88
7	SR 503/Atlantic Ave/I-5 NB Off-Ramp	Signal	WSDOT	D	39.0	D	0.64	41.1	D	0.66
8	SR 503/E CC St	Signal	WSDOT	D	36.4	D	0.46	32.9	C	0.59
9	SR 503/Millard Ave	TWSC	WSDOT	D	19.2	C	0.08	27.7	D	0.19

[1] *Delay = Intersection Average Control Delay for Traffic Signal and AWSC and Critical Movement Control Delay for TWSC*
[2] *LOS = Intersection Level-of-Service for Traffic Signal and AWSC and Critical Movement Level-of-Service for TWSC*
[3] *V/C = Intersection Volume-to-Capacity for Traffic Signal and Critical Movement Volume-to-Capacity for TWSC*
[4] *City of Woodland's Comp Plan does not provide LOS standards for roads with function class lower than Minor Arterial*

The following key observations will be used to inform the future conditions analysis and identify alternatives for improving the I-5/SR 503 interchange:

- As shown in Table 3, while the study intersections currently operate similarly during the AM and PM peak hours, traffic levels are generally higher during the weekday PM peak and therefore future conditions analyses will focus on the PM peak period.

- The percentage of heavy vehicles utilizing the northbound off-ramp at Exit 21 can range between approximately 10% to 30% during peak time periods.
- During these peak periods with heavy vehicle congestion, cycle failures can occur at the SR 503/Atlantic Avenue/I-5 NB off-ramp signalized intersection (i.e., vehicle queues do not clear under one cycle of green time) and queues have been observed spilling back into the mainline of I-5, resulting in both capacity and safety issues.
- Similarly, heavy congestion and long queues are experienced by many users of the SR 503/Pacific Avenue/I-5 SB on-ramp signalized intersection, particularly along the southbound approach where long vehicle queues (> 900 feet) have been observed along southbound Pacific Avenue.
- Heavy eastbound and westbound traffic volumes on SR 503 result in delays and cycle failures at the existing signalized intersections and the lack of pedestrian and bicycle facilities introduces challenges for non-motorized travel between the west and east sides of the community.
- Heavy mainline traffic volumes at the Goerig Street/Lakeshore Drive/Buckeye Street intersection are key factors that cause the intersection to exceed agency operating standards and makes it difficult for side street traffic to turn onto Goerig Street from Lakeshore Drive and/or Buckeye Street.



- STOP SIGN
- TRAFFIC SIGNAL

Existing Lane Configuration and Traffic Control Devices
Woodland, WA

Figure
02

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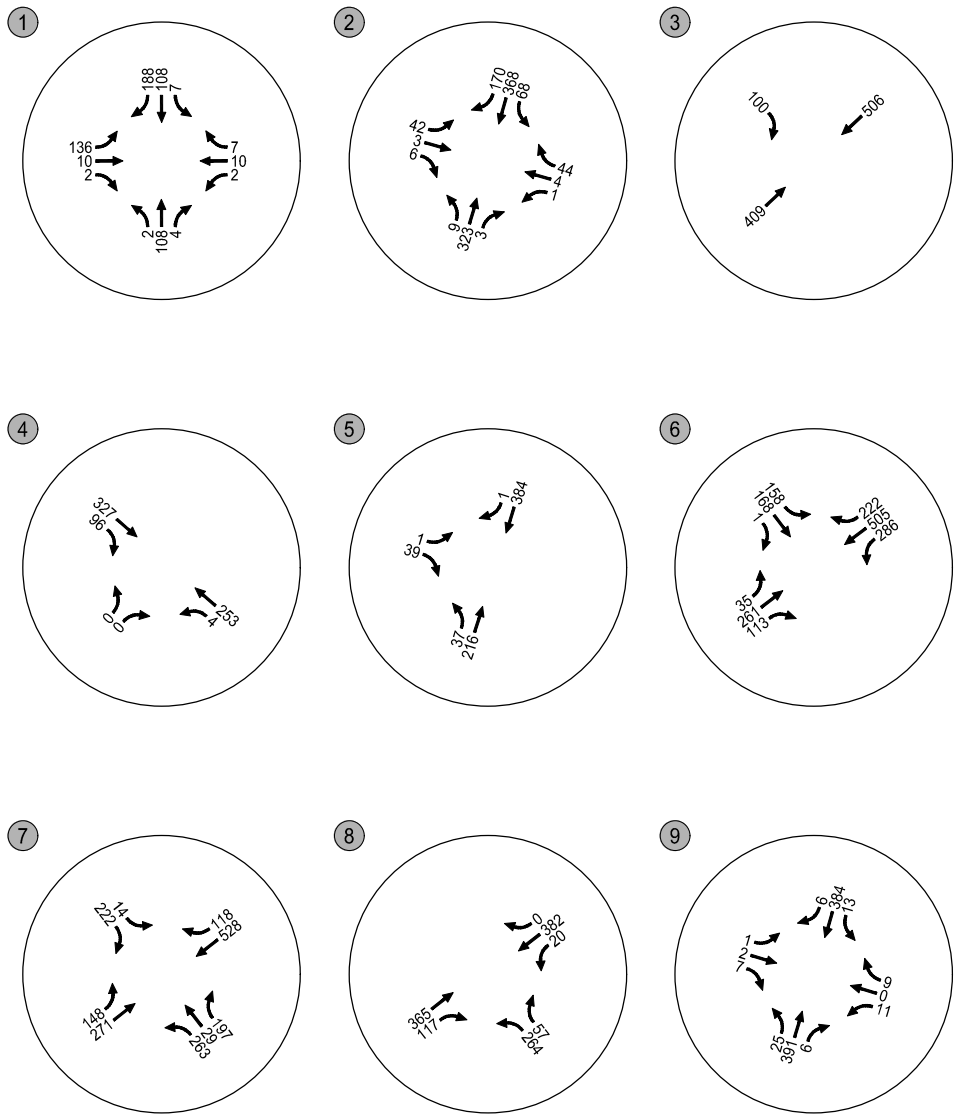

Existing Traffic Volumes
Weekday AM Peak Hour
Woodland, WA

Figure
03

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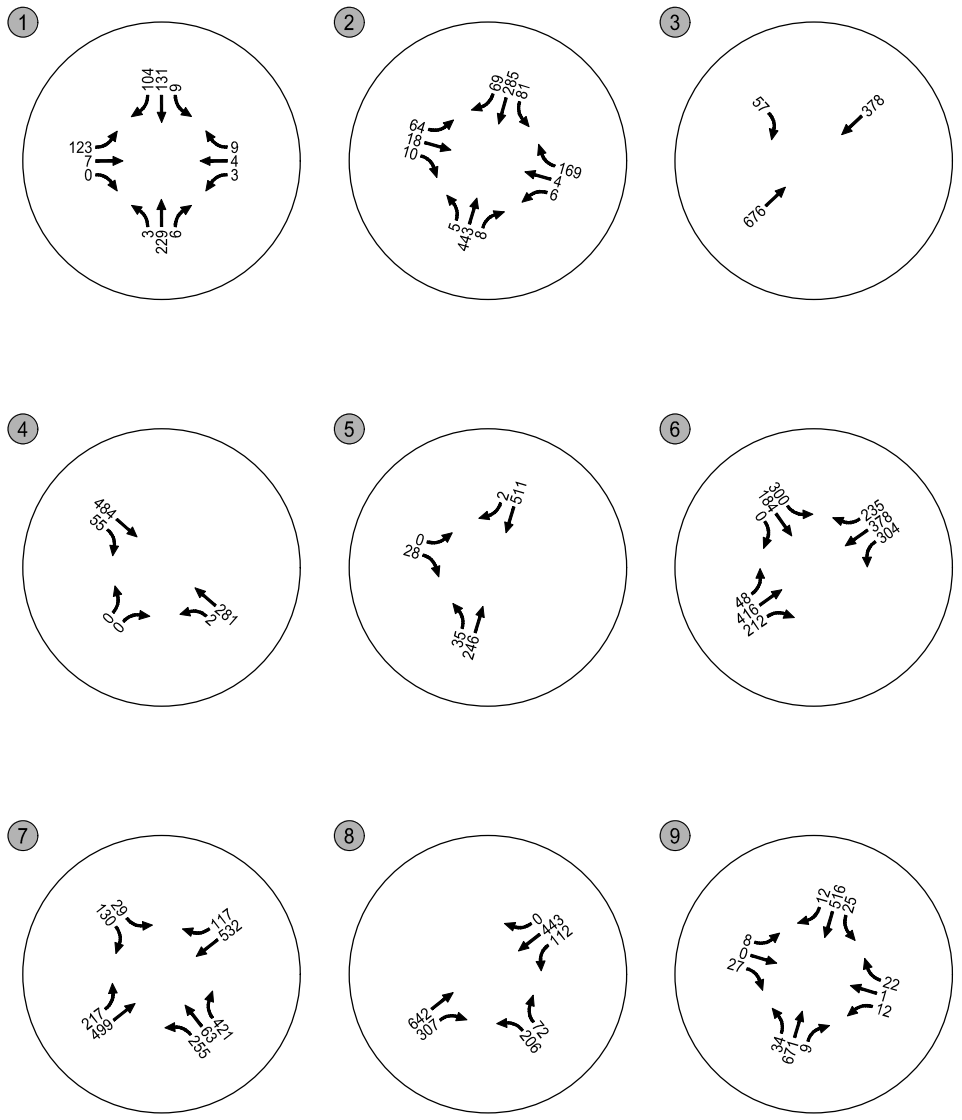

Existing Traffic Volumes
Weekday PM Peak Hour
Woodland, WA

Figure
04

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Traffic Safety

Historical crash data from the most recent five years at the study intersections was reviewed to identify potential safety issues or trends. WSDOT provided crash data from January 1, 2014 to December 31, 2018. Table 2 summarizes the reported crashes by type and severity.

Table 2 - Reported Crashes (2014 - 2018)

Intersection	Crash Type					Crash Severity		Total Crashes
	Angle/ Turning	Rear-End	Side Swipe	Ped/Bike	Fixed Object/Other	PDO	Injury	
Goerig St/Park Rd/Bozarth Ave	2	0	0	0	0	2	0	2
Goerig St/Lakeshore Dr/Buckeye St	4	2	0	0	0	4	2	6
Goerig St/Lewis River Rd	0	1	0	0	0	0	1	1
Goerig St/Pacific Ave	1	1	0	0	0	2	0	2
Pacific Ave/CC St	0	2	1	1	1	3	2	5
SR 503/Pacific Ave/I-5 SB On-ramp	16	5	0	0	0	14	7	21
SR 503/Atlantic Ave/I-5 NB Off-ramp	0	4	1	0	1	4	2	6
SR 503/E CC St	9	6	2	0	1	14	4	18
SR 503/Millard Ave	3	1	0	0	0	3	1	4

As shown in Table 2, a total of 65 crashes were reported at the study intersections during the five-year study period (2014 – 2018). Of these crashes, approximately 30 percent (19 crashes) resulted in injury (either possible injury or minor injury) and there were no reported fatalities. The intersection of SR 503/Pacific Avenue/I-5 on-ramp had the highest number of crashes, with nearly 33 percent (7 crashes) of the crashes resulting in injury. *Attachment "C" contains the crash data sheets.*

FUTURE YEAR 2040 NO-BUILD TRAFFIC CONDITIONS

The future no-build conditions analysis assesses the impacts of traffic growth on the transportation system and identifies deficiencies that may arise. The future conditions analysis estimates the future operational characteristics of the study intersections based on forecast traffic volumes.

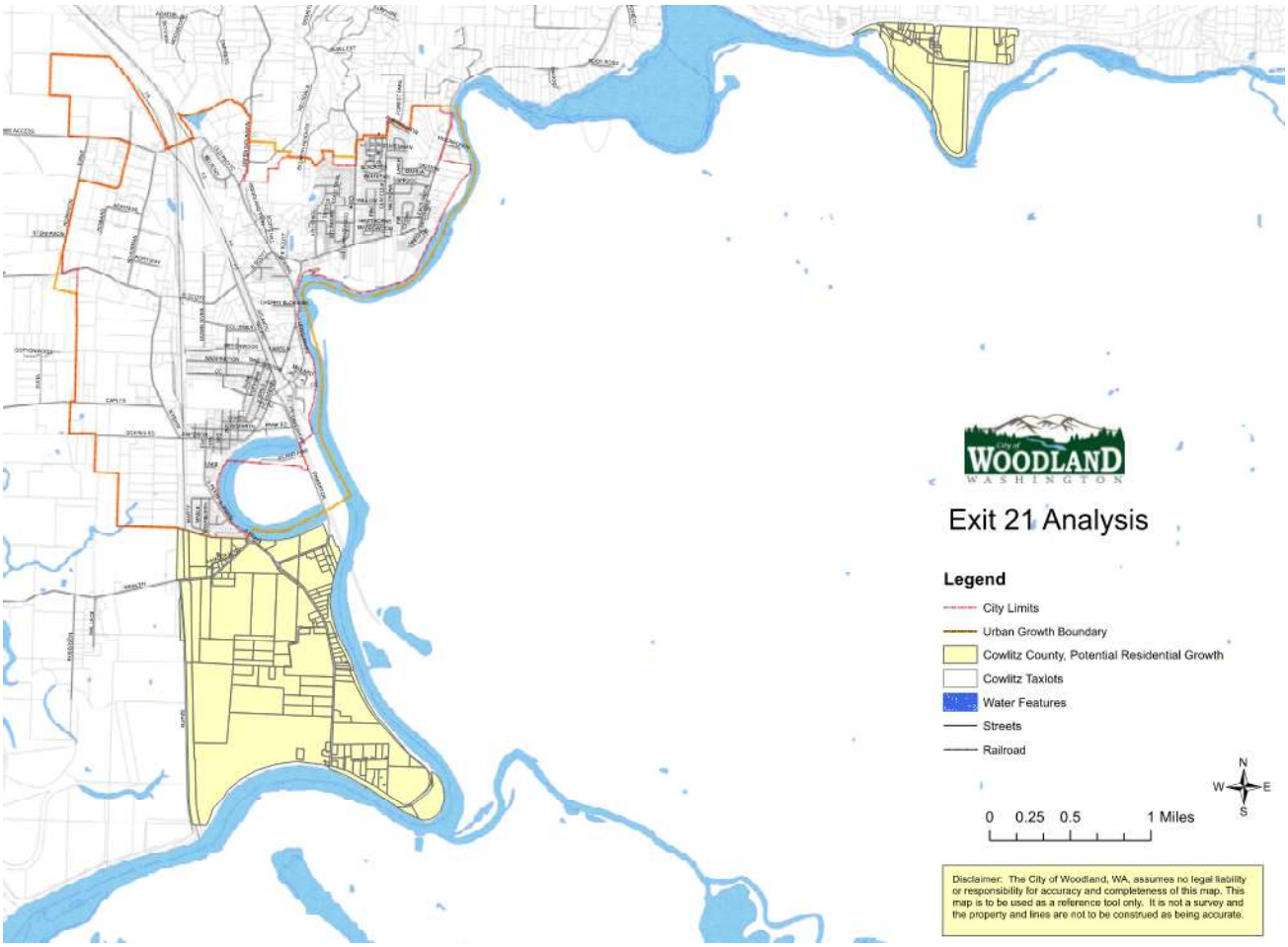
YEAR 2040 FORECAST VOLUME DEVELOPMENT

Forecast year 2040 peak hour vehicle turning movement volumes were developed based on a combination of factors including;

- May 2019 turning movement counts;
- A review of historical traffic counts at the study intersections;
- Previous study assessments of traffic growth; and,
- Travel demand data from the City of Woodland VISUM Travel Demand Model that reflects anticipated land use changes and planned transportation improvements within the City and surround areas.

An update to the City's travel demand model we performed by Transpo, with the City providing existing and future land use information. In addition to the land use forecasts within the city limits, City staff also provided information for two separate areas adjacent to the city that would also utilize Exit 21. The two areas are shown in the following graphic (Figure 5) and were included in the travel demand model to better accommodate the project needs throughout the Exit 21 study area. These two residential areas were assumed to include 1,000 single-family homes in the southwest area and 250 single-family homes in the northeast area.

Figure 5 - Potential Residential Growth Areas (Outside City Limits)

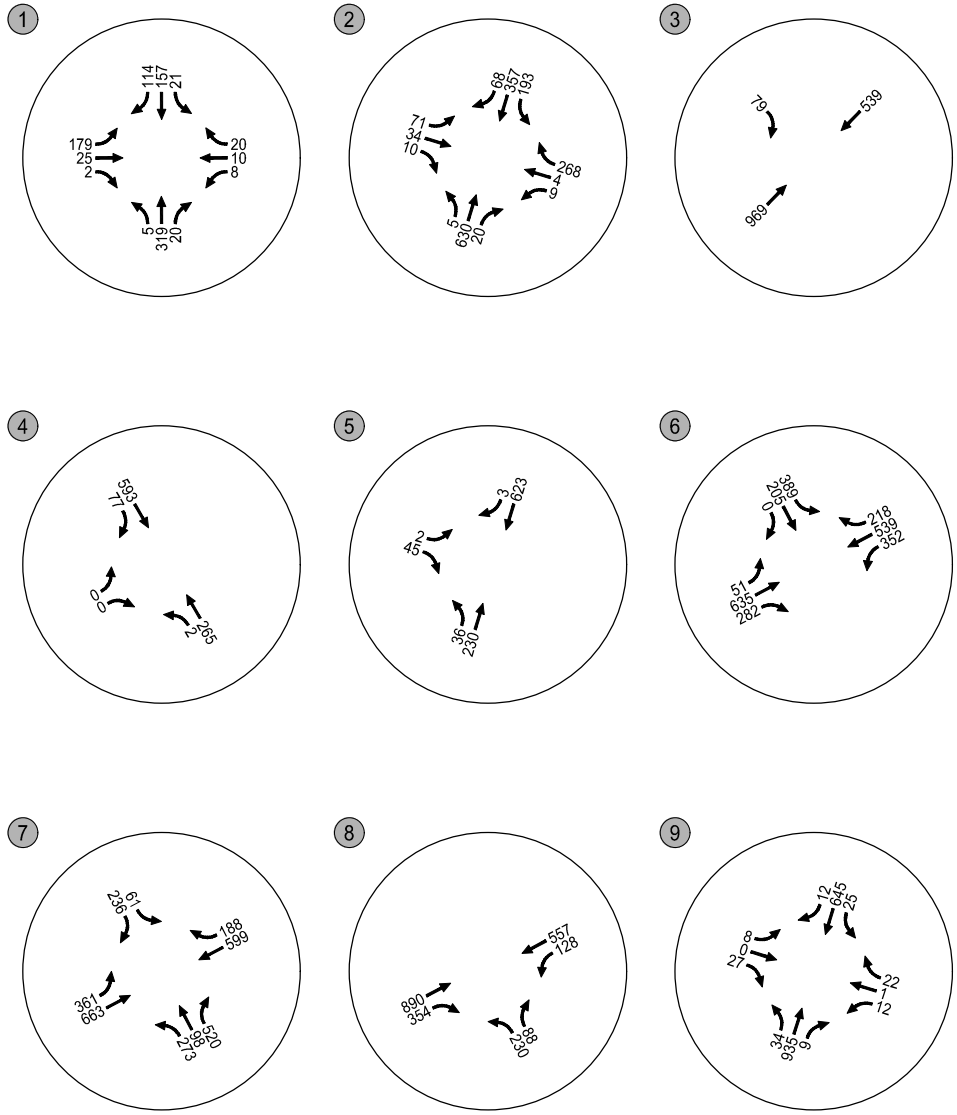


Note: Figure 5 graphic prepared by City of Woodland staff.

Attachment "D" contains the travel demand model volume plots provided by Transpo.

The 2040 weekday PM peak period turning movement volumes for the study intersections were developed using the methodology outlined in the National Cooperative Highway Research Program (NCHRP) 255 and 765.

The weekday PM peak hour was determined to be the critical time period in the existing conditions analysis. Therefore, future no-build and build conditions analyses focus on the forecast year 2040 weekday PM peak period to appropriately identify mitigations that meet the needs of the peak travel patterns. Figure 6 shows the forecast year 2040 PM peak hour traffic volumes.



Future 2040 Traffic Volumes
Weekday PM Peak Hour
Woodland, WA

Figure
06

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YEAR 2040 NO-BUILD TRAFFIC OPERATIONS ASSESSEMENT

Using the forecast year 2040 traffic volumes shown in Figure 6, traffic operational analysis was performed at the study intersections. Table 3 summarizes the operational performance at the study intersections under year 2040 no-build traffic conditions. *Attachment "E" contains the year 2040 future no-build operations worksheets.*

Table 3 - Year 2040 No-Build Traffic Operations Summary

Int. No.	Intersection	Control Type	Jurisdiction	LOS	Weekday PM Peak Hour		
					Delay (s/veh)[1]	LOS[2]	V/C[3]
1	Goerig St/Park Rd/Bozarth Ave	AWSC	City of Woodland	N/A[4]	24.1	C	0.85
2	Goerig St/Lakehouse Dr/Buckeye St	TWSC	City of Woodland	N/A[4]	>300	F	>1.0
3	Goerig St/Lewis River Rd	TWSC	City of Woodland	D	15.3	C	.21
4	Goerig St/Pacific Ave	TWSC	City of Woodland	D	9.8	A	0.01
5	Pacific Ave/CC St	TWSC	City of Woodland	D	16.8	C	0.13
6	SR 503/Lewis River Rd/Pacific Ave/I-5 SB On-ramp	Signal	WSDOT	D	46.7	D	>1.0
7	SR 503/Atlantic Ave/I-5 NB Off-Ramp	Signal	WSDOT	D	98.5	F	>1.0
8	SR 503/E CC St	Signal	WSDOT	D	78.7	E	0.96
9	SR 503/Millard Ave	TWSC	WSDOT	D	237.4	F	0.98

[1] *Delay = Intersection Average Control Delay for Traffic Signal and AWSC and Critical Movement Control Delay for TWSC*
[2] *LOS = Intersection Level-of-Service for Traffic Signal and AWSC and Critical Movement Level-of-Service for TWSC*
[3] *V/C = Intersection Volume-to-Capacity for Traffic Signal and Critical Movement Volume-to-Capacity for TWSC*
[4] *City of Woodland's Comp Plan does not provide LOS standards for roads with functional class lower than Minor Arterial*

As shown in Table 3, the Goerig Street/Lakehouse Drive/Buckeye Street, SR 503/Atlantic Avenue/I-5 NB off-ramp, SR 503/E CC Street, and SR 503/Millard Avenue intersections are expected to exceed agency operation standards in the no-build condition during the year 2040 weekday PM peak hour. The issues previously identified under existing conditions associated with heavy congestion, long vehicle queues, safety, and limitations to pedestrian/bicycle circulation and connectivity are all forecast to get worse under 2040 no-build conditions.

CONCEPTS DEVELOPMENT AND EVALUATION

The alternatives process applied a tiered approach to developing, evaluating, and screening alternatives for the I-5/SR 503 Interchange. The alternatives development began upon the completion of the existing and future year no-build traffic operations analysis. The initial alternatives were developed based on input from the Stakeholders City and TAC. Through this input, three major concepts and some additional alternatives to those concepts were identified and developed. Based on evaluation criteria, one major concept was removed from the options and the other two concepts were refined. The refined concepts included planning-level cost estimates, an evaluation criteria matrix, and detailed CAD designs. *Attachment "F" provides a sampling of sketch-level concepts and alternative designs prepared for this project.*

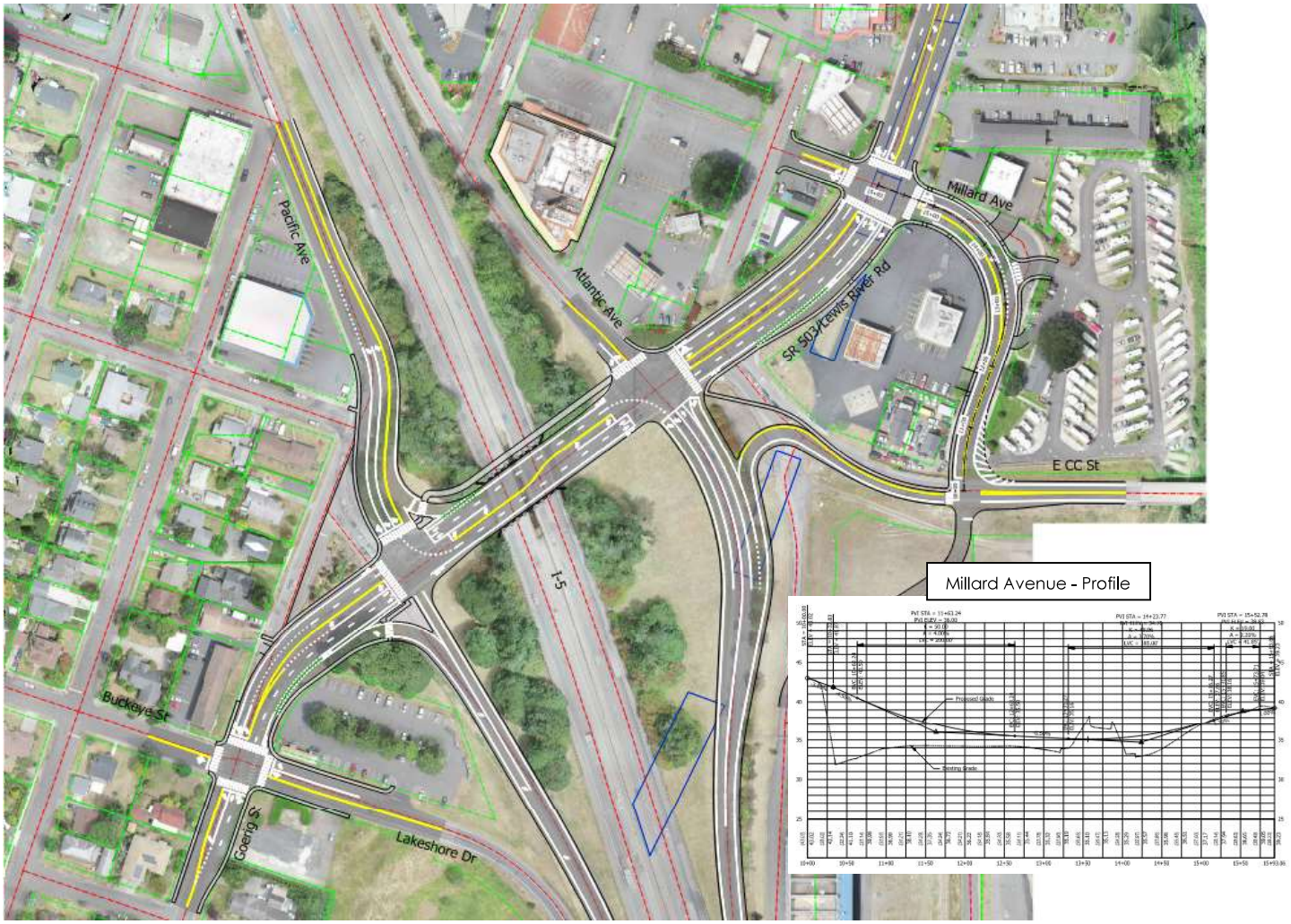
Based on the evaluation and screening of alternatives, the following concepts were advanced for further evaluation and refinements:

- Improved Signals
- Roundabouts

IMPROVED SIGNALS

The improved signals concept builds off the existing roadway network and incorporates traffic signals at every major intersection location as the control type. This concept limits impacts to private right-of-way and adjacent businesses and focuses on lane additions and signal timing improvements while keeping most intersections at the same location. The improved signals concept also proposes removing the intersection SR 503/E CC Street – to eliminate the "cluster signals" issue – and creates a new connection from E CC Street to Millard Avenue. Figure 7 shows the improved signals concept, including assumed lane configurations and traffic control devices.

Figure 7 – Improved Signals Concept



Key features of the Improved Signals Concept include:

- E CC Street realignment to create a new intersection with Millard Avenue.
- New signals at SR 503/Millard Avenue and Goerig Street/Lakeshore Drive/Buckeye Street.
- Lane additions at both I-5 ramp intersections.
- Removal of the traffic signal and intersection at the existing SR 503/E CC Street intersection.
- Slip-lane from the I-5 NB off-ramp to E CC Street.
- Comprehensive bicycle and pedestrian facilities to accommodate east-west travel through the interchange.

Attachment "G" provides a more detailed view of the Improved Signals Concept Design with scalebar.

Improved Signal - 2040 Traffic Operations

Table 6 provides a summary of the 2040 future build operations for the improved signals concept. *Attachment "H" contains the year 2040 build traffic operations worksheets.*

Table 6 – Improve Signals Concept: Year 2040 Build Traffic Operations Summary

Intersection	Weekday PM Peak Hour		
	Delay (s/veh)[1]	LOS[2]	V/C[3]
Goerig St/Park Rd/Bozarth Ave	12.9	B	0.60 (NB)
Goerig St/Lakeshore Dr/Buckeye St	51.6	D	0.80 *
SR 503/Pacific Ave/I-5 SB On-ramp	34.9 *	C *	0.80 *
SR 503/Atlantic Ave/I-5 NB Off-ramp	43.4 *	D *	0.93 *
SR 503/Millard Ave	15	B	0.64 *

[1] *Delay = Intersection Average Control Delay for Traffic Signal and AWSC and Critical Movement Control Delay for TWSC*
[2] *LOS = Intersection Level-of-Service for Traffic Signal and AWSC and Critical Movement Level-of-Service for TWSC*
[3] *V/C = Intersection Volume-to-Capacity for Traffic Signal and Critical Movement Volume-to-Capacity for TWSC*
** Based on HCM 2000 Reports*

As shown in Table 6, all study intersections are forecast to operate at a level that meets agency intersection performance standards during the year 2040 weekday PM peak hour.

In addition to the intersection operations analysis, an assessment of the 95th percentile queues was performed using SimTraffic software at the study intersections during the weekday PM peak hours and is summarized in Table 7.

Table 7 – Improved Signals Concept: Year 2040 Build Conditions – Queue Summary

Intersection	Control Type	Approach/ Movement	Weekday PM Peak Hour 95th Percentile Queues (feet)	Storage per current concept
Goerig St/Lakeshore Dr/Buckeye St	Signal	EB (LTR)	646	200 [1]
		WB (LT)	1458	1200
		WB (R)	175	100
		NB (L)	125	100
		NB (TR)	1508	192 [1]
		SB (L)	350	335 [1]
		SB (TR)	349	335 [1]
SR 503/Pacific Ave/I-5 SB On-ramp	Signal	EB (L)	200	100
		EB (T)	375	335 [1]
		EB (R)	275	250
		WB (L)	185	125
		WB (T)	443	355 [1]

		SB (L)	221	290
		SB (L)	218	680 [1,2]
		SB (TR)	390	680 [1]
SR 503/Atlantic Ave/I-5 NB Off-Ramp	Signal	EB (L)	150	125
		EB (T)	433	355 [1]
		WB (T)	406	355 [1]
		NB (L)	240	400
		NB (L)	270	400
		NB (T)	391	1140 [1]
		NB (R)	457	400
		SB (L)	225	200
		SB(R)	796	400 [1]
SR 503/Millard Ave	Signal	EB (L)	150	125
		EB (T)	433	355 [1]
		WB (T)	406	355 [1]
		NB (L)	240	400
		NB (L)	270	400
		NB (T)	391	1140 [1]
		NB (R)	457	400
		SB (L)	225	200
		SB(R)	796	400 [1]

m = Volume of 95th percentile queue is metered by upstream signal.

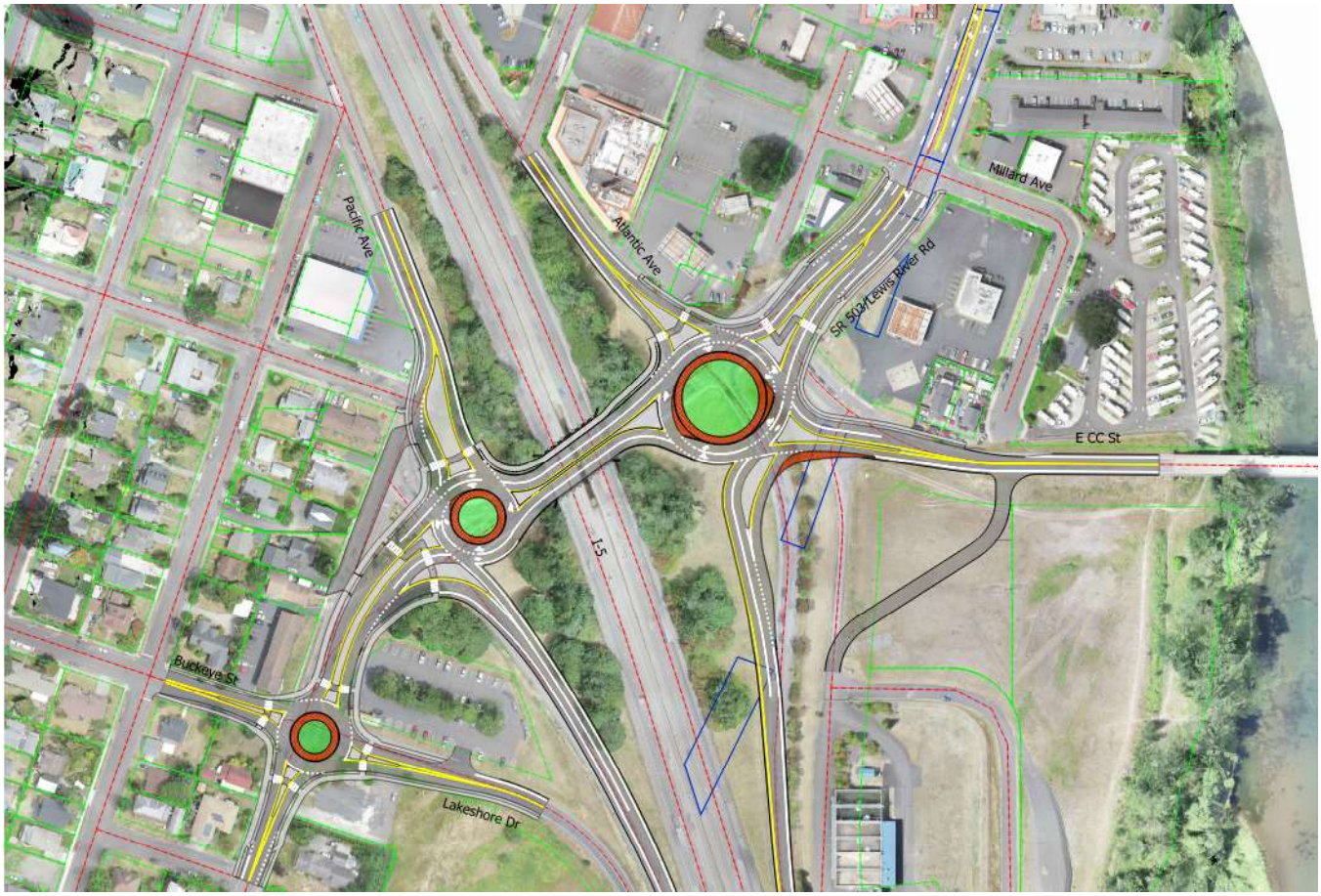
**The distance to upstream intersection.*

As shown above in the improved signals concept operations tables, the SR 503/Atlantic Avenue/I-5 NB Off-ramp and SR 503/Pacific Avenue/I-5 SB On-ramp intersections are forecast to operate acceptably and accommodate the estimate queues along the critical I-5 NB Off-ramp and the southbound approach of Pacific Avenue. In order to prioritize certain critical approaches such as the I-5 NB Off-ramp to prevent queues from spilling back into the I-5 mainline, other movements at several intersections were impacted and several queues were reported by SimTraffic to extend beyond the storage lengths shown in the current improved signals concept. Should the improved signals concept be advanced for further evaluation and design, additional refinements to signal timing and storage lengths will be needed.

ROUNDABOUTS CONCEPT

The roundabouts concept improves traffic operations and safety while also eliminating the inefficient cluster signal on SR 503 at the I-5 NB off-ramp and E CC Street. This concept proposes most intersections in the same location, however, Goerig Street/Lakeshore Drive, SR 503/I-5 SB on-ramp and the SR 503/I-5 NB off-ramp intersections would be reconstructed as roundabouts. Figure 8 shows the roundabouts concept, including assumed lane configurations and traffic control devices.

Figure 8 – Roundabouts Concept



Key features of the Roundabouts Concept include:

- 4-Leg single-lane roundabout at the intersection of Goerig Street/Lakeshore Drive/Buckeye Street.
- 4-Leg multi-lane roundabout at the intersection of SR 503/Pacific Avenue/I-5 SB on-ramp.
- 5-Leg multi-lane roundabout at the intersection of SR 503/Atlantic Avenue/E CC Street/I-5 NB off-ramp. This includes the realignment of E CC Street to convert the existing two signalized intersections into a single 5-leg roundabout intersection.
- Lane addition to the NB off-ramp for increased queueing capacity.
- Right turn slip-lane from I-5 NB off-ramp to E CC St.
- Right turn slip lane from Goerig Street to I-5 SB on-ramp
- Comprehensive bicycle and pedestrian facilities to accommodate east-west travel through the interchange.

Attachment "I" provides a more detailed view of the Roundabouts Concept Design with scalebar

Roundabouts - 2040 Traffic Operations

WSDOT provides specific guidance for the analysis of roundabouts in their *WSDOT Sidra Policy Settings* document. This traffic analysis strictly adhered to the policy document to ensure it meets expectations of WSDOT staff. To mitigate any potential risk inherent to SIDRA's analysis methodology, a second analysis was completed using the *Highway Capacity Manual 6th Edition (HCM 6)* Standards. While the

HCM 6 results may not be solely used to determine viability of this alternative, they should be considered to identify potential problem areas as traffic increases in the study area and surrounding region.

Table 8 provides a summary of the future build operations for the roundabouts concept according to the SIDRA Standard method of analysis. *Attachment "J" contains the Roundabouts Concept year 2040 build traffic operations worksheets.*

Table 8. Roundabouts Concepts: Year 2040 Build Traffic Operations Summary (SIDRA Standard Method)

Intersection		Weekday 2040 PM Peak Hour Operations				
	Metric	NB	SB	EB	WB	NW (CC St. only)
Goerig St. & Lakeshore Dr.	Delay (s/veh) [1]	15.5	5.8	10.5	12	N/A
	V/C[3]	0.76	0.77	0.42	0.75	N/A
	LOS[2]	B	A	B	B	N/A
	95% Queue (ft)	100	125	50	100	N/A
I-5 SB Ramp Terminal	Delay (s/veh)	N/A	28.7	7.4	5.5	N/A
	V/C	N/A	0.78	0.49	0.77	N/A
	LOS	N/A	C	A	A	N/A
	95% Queue (ft)	N/A	125	50	125	N/A
I-5 NB Ramp Terminal (5 Leg)	Delay (s/veh)	10.0	10.8	5.4	15.3	11.8
	V/C	0.62	0.66	0.42	0.63	0.3
	LOS	A	B	A	B	B
	95% Queue (ft)	50	50	50	75	25

[1] *Delay = Intersection Average Control Delay for Traffic Signal and AWSC and Critical Movement Control Delay for TWSC*
[2] *LOS = Intersection Level-of-Service for Traffic Signal and AWSC and Critical Movement Level-of-Service for TWSC*
[3] *V/C = Intersection Volume-to-Capacity for Traffic Signal and Critical Movement Volume-to-Capacity for TWSC*

As shown in Table 8, the roundabouts are expected to operate acceptably through the 2040 design year. A primary driver for this project is to eliminate vehicle queue spillbacks from the I-5 NB ramp terminal intersection to the I-5 NB mainline, and the roundabouts and available storage on the off-ramp are expected to accommodate the estimated 95% queues.

Table 9 provides a summary of the future build operations for the Roundabouts concept according to the *Highway Capacity Manual 6th Edition* method of analysis. *Attachment "J" contains the year 2040 build traffic operations worksheets.*

Table 9. Roundabouts Concepts: Year 2040 Build Traffic Operations Summary (Highway Capacity Manual 6th Edition Model)

Intersection		Weekday 2040 PM Peak Hour Operations					Weekday 2040 PM Peak Hour Operations w/ Meter at NB Off-Ramp				
	Metric	NB	SB	EB	WB	NW (CC St. only)	NB	SB	EB	WB	NW (CC St. only)
Goerig St. & Lakeshore Dr.	Delay (s/veh) [1]	43.1	16.6	13.9	27.9	N/A	52.5	18.4	15.0	30.6	N/A
	V/C[3]	0.91	0.77	0.46	0.82	N/A	0.97	0.80	0.48	0.84	N/A
	LOS[2]	D	B	B	C	N/A	D	C	B	C	N/A
	95% Queue (ft)	175	100	50	125	N/A	200	150	50	150	N/A
I-5 SB Ramp Terminal	Delay (s/veh)	N/A	45.3	22.6	14.6	N/A	N/A	**138.0**	46.8	17.2	N/A
	V/C	N/A	0.93	0.78	0.81	N/A	N/A	**1.36**	0.97	0.86	N/A
	LOS	N/A	D	C	B	N/A	N/A	**F**	D	B	N/A
	95% Queue (ft)	N/A	125	75	125	N/A	N/A	**475**	125	150	N/A
I-5 NB Ramp Terminal (5 Leg Option)	Delay (s/veh)	**138.3**	52.4	9.3	38.8	45.9	47.6	43.7	8.2	28.6	27.6
	V/C	**1.28**	0.93	0.53	0.83	0.69	0.99	0.9	0.68	0.78	0.55
	LOS	**F**	D	A	D	D	D	D	A	C	C
	95% Queue (ft)	**450**	125	50	100	50	225	100	225	75	50

[1] *Delay = Intersection Average Control Delay for Traffic Signal and AWSC and Critical Movement Control Delay for TWSC*
[2] *LOS = Intersection Level-of-Service for Traffic Signal and AWSC and Critical Movement Level-of-Service for TWSC*
[3] *V/C = Intersection Volume-to-Capacity for Traffic Signal and Critical Movement Volume-to-Capacity for TWSC*

As shown in Table 9, the operations results based on the HCM 6 method of analysis generally indicate higher expected delay times, volume/capacity, and queue lengths when compared to the SIDRA Standard results in Table 8. A specific area of concern is the expected delay and queue length at the I-5 NB off-ramp of 138.3 seconds and 450 feet, respectively. In response to this concern, additional mitigation options were considered in case actual future 2040 conditions turn out to be closer to the HCM 6 results. One such mitigation is to install a metering signal at the eastbound approach (west leg) of the SR503/I-5 NB off-ramp intersection (results shown in the last 5 columns of Table 10). Metering the intersection shifts the delay and vehicle queues away from the I-5 NB off-ramp, thus minimizing the potential for spillbacks onto the I-5 NB mainline, however, additional delay and queues are expected onto adjacent intersections and side streets such as at the southbound approach to the SR 503/I-5 SB ramp terminal intersection.

As noted above, the HCM 6 results may not be solely used in determining the effectiveness of the roundabout concepts, however, they should be considered to mitigate potential risk if future operating conditions become worse than expected.

STAKEHOLDER ENGAGEMENT & PUBLIC INVOLVEMENT

Opportunities for stakeholder and public involvement were made available throughout the overall project.

STAKEHOLDER AND TECHNICAL ADVISORY COMMITTEE ENGAGEMENT

Stakeholder and Technical Advisory Committee (TAC) meetings were held to better understand and discuss key project issues and gather information regarding existing conditions and constraints that would affect the project. The Stakeholders and TAC also served as a sounding board to help guide key issues and decisions toward identifying a concept that helps to achieve a better transportation system for all users. The Stakeholders are the City of Woodland, Washington State Department of Transportation (WSDOT), and the Cowlitz-Wahkiakum Council of Governments (CWCOG). These members are served on the TAC and were joined by representatives from Clark County, Cowlitz County, Port or Woodland, and Federal Highway Administration (FWHA).

PUBLIC ENGAGEMENT

A variety of public engagement opportunities were provided that ranged from small group meetings organized by City staff, to targeted meetings with members of the local trucking industry. A trucking industry meeting was held on January 28, 2020 and questionnaire/comment forms are provided in Attachment "K". As shown in the questionnaire/comment forms, the members of the local trucking industry generally support the project to improve Exit 21, and both the improved signals and roundabouts concepts have their supporters and critics.

The major public engagement opportunities were the 10/17/2019 Woodland Planning Commission meeting, 12/16/2019 Woodland City Council meeting, and 2/13/2020 public open house. The public open house that was held on February 13, 2020 was an opportunity to share the latest design concepts with the public and gather input and feedback to help refine the design concepts. Approximately 100 individuals attended the open house and both concepts received support from the community. While many individuals did identify a preferred concept, both concepts received a close number of supporters, and several attendees acknowledged that both concepts would improve traffic conditions and could support either concept. *Attachment "L" contains the public comment sheets from the 2/13/2020 public open house.*

A final presentation was made at the 10/5/2020 City Council meeting to provide a summary of key findings for both concepts.

SUMMARY AND CONCLUSION

Based on the tiered approach to developing, evaluating, and screening alternatives for the I-5/SR 503 Interchange (Exit 21), the Improved Signals and Roundabouts concepts both help achieve improved operations and safety throughout the interchange aera for all motorized and non-motorized users.

The recommended concepts provide several key benefits to the interchange area and are listed below:

- Intersection capacity is expected to increase at all intersections along SR 503 between Lakeshore Drive and Millard Avenue, including at both I-5 ramp terminal intersections.
- Excessive vehicle queues on the I-5 northbound off-ramp will be significantly reduced with the addition of either a signal or roundabout improvement at the ramp terminal intersection; mitigating vehicle queue spillbacks onto the mainline of I-5.
- A right turn by-pass lane is proposed under both concepts from the I-5 northbound off-ramp to E CC Street to improve traffic flow and help alleviate congestion on SR 503.
- Large trucks are expected to be able to navigate both improvement concepts.
- Pedestrian and bicycle facilities will be provided throughout the interchange area, including a separated multi-use path along the north side of SR 503 between the ramp terminals.
- The improved signals concept provides more flexibility to construct improvements in phases, which could better match available funding and desired improvement schedules.

The transportation assessment in this report, coupled with public feedback, guidance from stakeholders, and available funding are meant to help inform the City with selecting a preferred concept for Exit 21.

At the City Council meeting on 11/02/2020, the City Council voted to select the improved signals concept as the preferred alternative to be advanced for further analysis and preliminary design. A recording of the full council meeting can be viewed here: https://youtu.be/kyswJTb6-MA?t=3133

REFERENCES

1. Transportation Research Board (TRB). *Highway Capacity Manual, 2000.* 2000.
2. Transportation Research Board (TRB). *Highway Capacity Manual, 6th Edition.* 2010.

ATTACHMENTS

A. Turning Movement Count Data
B. Year 2019 Existing Traffic Operations Worksheets
C. Crash Data
D. Travel Demand Model Sheets
E. Year 2040 Future No-Build Traffic Operations Worksheets
F. Sketch-Level Concepts
G. Improved Signals Concept
H. Improved Signals Concept – 2040 Traffic Operations Worksheets
I. Roundabouts Concept
J. Roundabouts Concept – 2040 Traffic Operations Worksheets
K. Trucking Industry Questionnaire/Comment Forms
L. February 13, 2020 Public Open House – Comment Sheets