

**STATE OF OREGON**

**INTEROFFICE MEMO**

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**SUBJECT: Hwy OR 99W South Corvallis Facility Plan**  
**Future No-build Motor Vehicle Conditions Intersection Analysis,**  
**Task 8.2, FINAL Technical Memorandum #12**

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This memorandum documents the 2040 future no-build conditions for the Highway OR 99W South Corvallis Facility Plan, including the methodology and key assumptions used in the operational analysis. The analyzed future conditions found extensive congestion issues in the southbound direction radiating from the Avery Avenue/Crystal Lake Drive intersection to the north extent of the study area. In future conditions, this section of OR 99W is at, and at some locations over, capacity and is unstable, so a reduction in green time at the Avery Avenue/Crystal Lake Drive intersection has a relatively large impact. Also, there are delay issues typical for two-way stop controlled minor streets attempting to make left turns onto a major through roadway. These issues are exacerbated by incomplete interchange connections as well as some closely spaced intersections and pedestrian crosswalks.

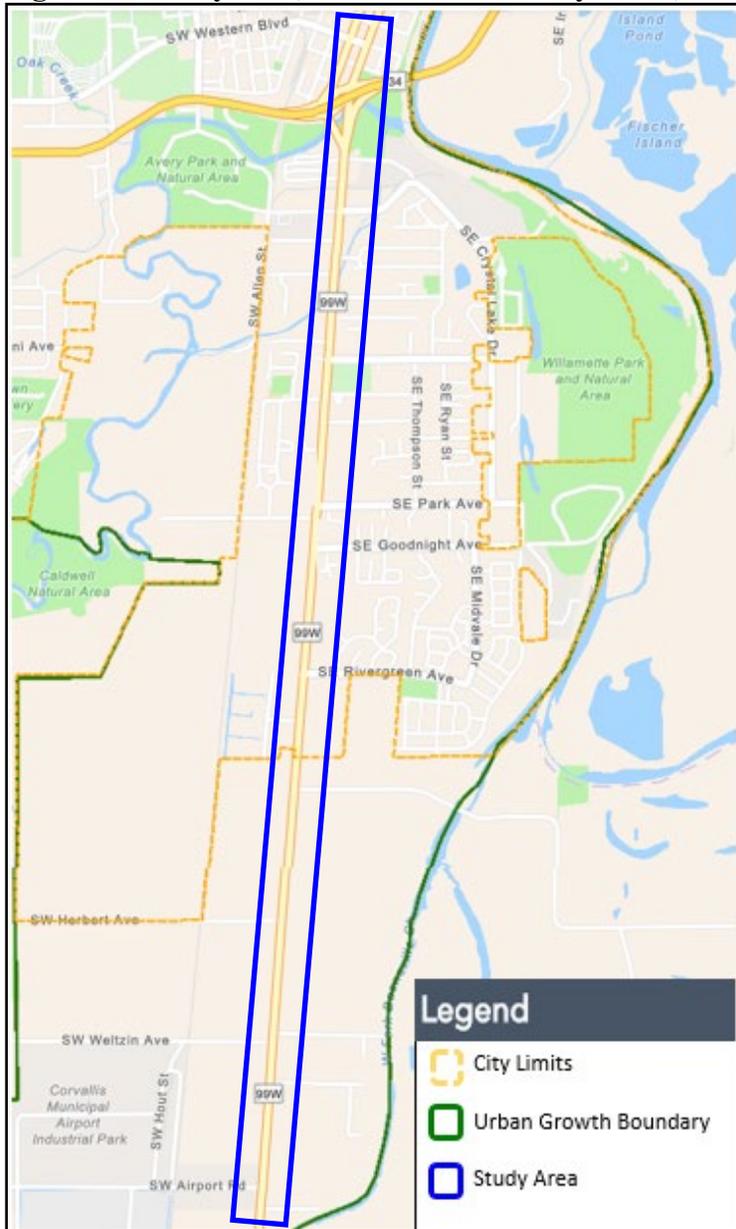
**Background**

The primary purpose of the South Corvallis Facility Plan is to make the OR 99W corridor a more safe, comfortable, and attractive place to walk and bike while also addressing traffic operations, mobility, and access. The recently completed Corvallis and Benton County Transportation System Plans cite this plan as a high and medium priority effort, respectively.

The study area encompasses the OR 99W highway corridor from SW Western Boulevard at the northern limit to the City of Corvallis southern urban growth boundary (see Figure 1). The character of the corridor changes significantly from a central business district at

the north, through a mixed commercial/residential area, ending at the south project limit in a general rural context. OR 99W throughout the study area is functionally classified as an urban principal arterial. Western Boulevard is a minor arterial. The east-west roads intersecting the corridor which are functionally classified as major collectors include: SE Crystal Lake Drive, SE Alexander Avenue, SE Park Avenue, SE Goodnight Avenue, SE Rivergreen Avenue, SE Kiger Island Drive, and SW Airport Avenue. The remainder of the study area roadways are classified as local streets: including SW B Avenue, SW Twin Oaks Circle/SE Chapman Place, SW Avery Avenue, SE Viewmont Avenue, SW Tunison Avenue, SE Richland Avenue, and SW Wake Robin Avenue. The posted speed on OR 99W is 25 mph at the north end of the study area and increases to 30 mph around SE Crystal Lake Drive, to 35 mph around SE Park Avenue, and finally to 50 mph around SE Goodnight Avenue. Additionally, there is a “School 20 mph” restriction zone on school days between 7 am and 5 pm around Lincoln Elementary School. The posted speed in the surrounding residential areas is generally 25 mph.

**Figure 1 – Study area, South Corvallis City limits, UGB limits**



**2040 Future No-build Volume Development**

The current Version 3.001 RTP Corvallis-Albany-Lebanon Model (CALM) regional travel demand forecasting model was used as the basis for creating the 2040 volumes. Missing roadway links and additional zone connectors were added as needed to evaluate growth on pertinent study area local roadways.

The 2010 base and 2040 future scenarios were then post-processed using the 2020 volumes developed in Tech Memo #9, following NCHRP (National Cooperative Highway Research Program) Report 255/765 techniques to obtain 2040 roadway link volumes. Post-processed turn movement volumes and process documentation are available in Appendix A. Directional CALM model link volumes for each segment of

modeled roadway in the project area for both daily and the pm peak hour are available in Appendix B.

Also included in the future no-build scenario are high-priority, financially constrained projects identified in the City of Corvallis and Benton County Transportation System Plans (TSP) that are within the study area or nearby and anticipated to have a direct significant impact on the study area. Additionally assumed to be included in the future no-build scenario are study area projects identified in the Statewide Transportation Improvement Program (STIP) as well as City of Corvallis Capital Improvement Program (CIP) projects. The STIP and CIP projects are funded and should be built within five years. The TSP projects are included as they are high-priority and have a high likelihood of being constructed within the 20 year project horizon. Projects included are identified in Table 1.

**Table 1: Projects Included in Future No-build Scenario**

Project ID	Description	Source
PB15	New Multi-Use Path: Construct a 3.5-mile multi-use path parallel to the railroad in Southeast Corvallis, between Marys River south to Airport Avenue.	CIP/ Corvallis TSP
PB17	Ped/Bike Crossing: Construct a bicycle/pedestrian bridge over Marys River and construct multi-use paths to connect the Pioneer Park trail network on the north side to the South Corvallis Multi--Use Path (project PB15) on the south side.	CIP
PB27	Study feasibility of new bicycle/pedestrian bridge over Marys River along the Goodnight Avenue – Brooklane Place alignment.	Corvallis TSP
PB49	New Multi-Use Path: Develop new multi-use path connecting Goodnight Avenue and Brooklane Drive, via Caldwell Natural Area. Connect to Willamette Park via the low-stress network along Goodnight Avenue to Park Avenue (B22). Project PB27 is required as Phase 1 of this project.	Corvallis TSP
A10	OR 99W/ Goodnight Ave Traffic Control: Options may include installing roundabout or traffic signal, when warranted which may be dependent on the construction of Project A11. Improvement cannot occur until Project A48 <sup>1</sup> is complete and should be coordinated with Project M126 <sup>2</sup> . Traffic signal warrants must be met and the State Traffic Engineer's approval obtained before a traffic signal can be installed on a state highway. This project may also be development driven and not just a City project.	Corvallis TSP
A11	OR 99W/Rivergreen Ave Traffic Control: Options may include constructing roundabout or traffic signal, when warranted which may be dependent on the construction of Project A10. Traffic signal warrants must be met and the State Traffic Engineer's approval obtained before a traffic signal can be installed on a state highway.	Corvallis TSP
K20221 <sup>3</sup>	Install a Bicycle signal head with protected bicycle signal phase at the signalized intersection of OR 99W and Crystal Lake Drive.	STIP

<sup>1</sup>Project A48 – ROW acquisition to allow realignment of Goodnight Avenue to make a 4-way intersection at Goodnight Avenue/OR 99W.

<sup>2</sup>Project M126 – Realign Goodnight Avenue west of OR 99W to form a 4-legged, 90-degree intersection at OR 99W/SE Goodnight Avenue.

<sup>3</sup> Additional diagrams and documentation regarding the bike phase at the Crystal Lake Drive signal project are available in Appendix C.

Note that the 2018 amendment to the City's Comprehensive Plan which resulted in a zone change of several parcels of land to high density residential (RS-20) was not included in the analysis. To satisfy the State's Transportation Planning Rule (TPR) a separate analysis was conducted to evaluate the effect of these changes. The overall net effect of the zone changes within the Study Area was minimal (less than 50 trip net increase). However, this small net volume increase will be included in the assumed volumes for upcoming alternatives.

Projected 2040 pedestrian and bicycle volumes were estimated using the City population forecasts from Portland State University's Population Research Center. The 2017 population forecast was averaged with draft population values for the Regional Transportation Plan (RTP) work currently in process for the Corvallis Area Metropolitan Planning Organization (CAMPO). The 2020-2040 population forecasts estimate a change in city population over the next 20 years to 2040 to be just over 12,000, which translates into a 0.97% yearly rate. The 2040 pedestrian and bicycle volumes are shown in Appendix A.

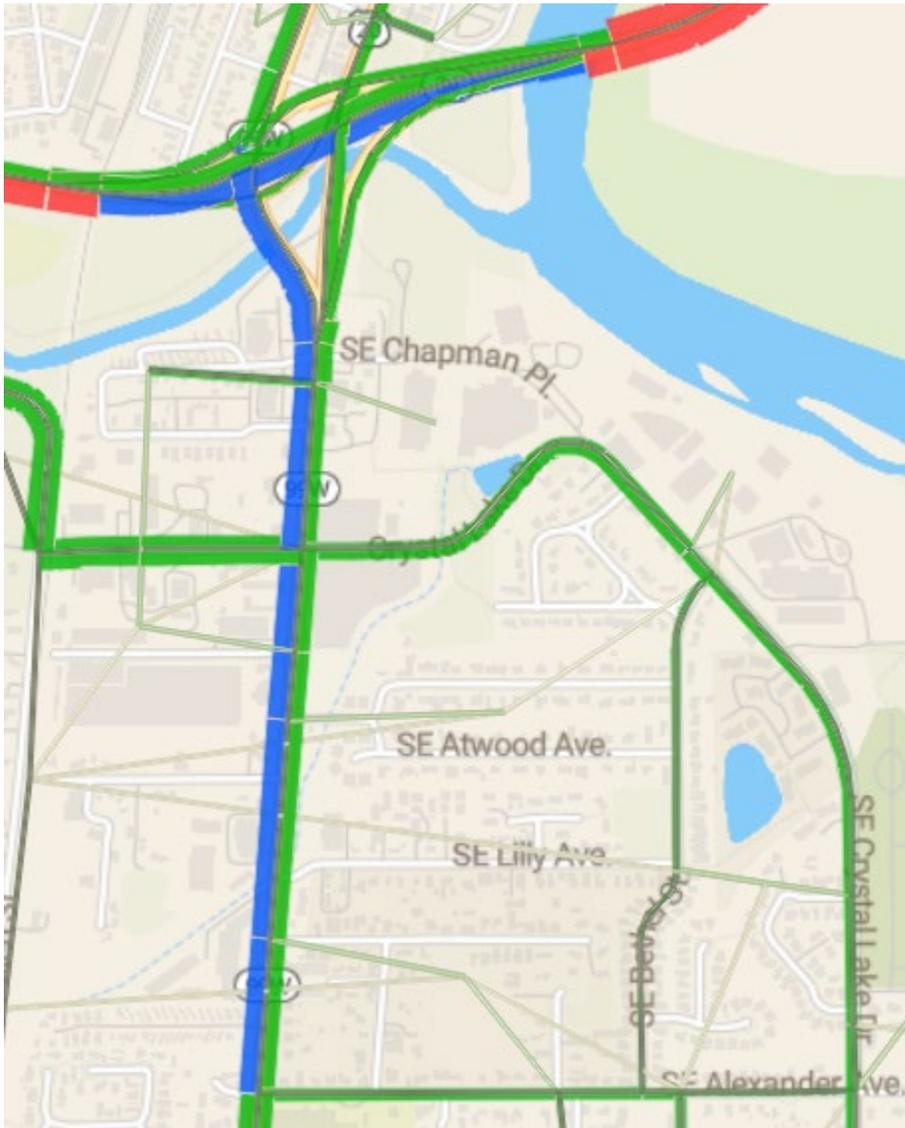
## **2040 Future No-build Condition Analysis Results**

### **Planned Future Travel Demand Forecast**

The CALM regional travel demand model was used to provide outputs for the typical weekday daily and PM peak hour to support specific and comparative analysis efforts in subsequent project tasks. The traffic volume growth and associated effects on traffic operations are a reflection of the future Comprehensive Plan assumptions and implicit household and employment allocations provided by the City.

The directional demand to capacity ratio (d/c) is one of the CALM outputs. Note that the d/c output from the model is a very different measure than the volume to capacity ratio (v/c) generated from the full post-processing analysis methodology. The d/c output from the model does not evaluate cumulative delay or queuing. Each segment within CALM is evaluated separately meaning queuing is essentially vertically stacked and not accumulated horizontally. Additional steps are required to produce the v/c typically used to evaluate intersection operations. Figure 2 depicts the d/c values at the north section of the study area (d/c plots for the entire study area for both daily and the PM peak hour are available in Appendix B). A d/c between 0.90 and 1.10 is considered to be at capacity and a d/c value greater than 1.10 reflects overcapacity conditions. As depicted in Figure 2, the southbound stretch of OR 99W between the OR 34 ramps and SE Alexander Avenue is at capacity. Furthermore, OR 34/US 20 has a d/c greater than 1.10 which shows overcapacity conditions in the surrounding area as well. This is an indication of instability and any disruption to the system will have a significant impact.

**Figure 2: CALM PM Peak d/c Plot**



Style	from ( $\geq$ )	to ( $<$ )
A	0.00	0.90
A	0.90	1.10
A	1.10	12.00

The trip length and average travel time between six origin-destination pairs for vehicles were evaluated using CALM for both daily and the PM peak hour to create a comparative base for the upcoming alternatives. The analysis results are in Table 2. Volumes can vary significantly by direction during the PM peak hour causing differing travel times between the same origin and destination. For this reason the analysis was performed in both directions for each O-D pair.

**Table 2: Origin-Destination Travel Time and Trip Length**

Origin	Destination	Direction	PM Peak		Daily	
			Travel Time (min)	Trip Length (mi)	Travel Time (min)	Trip Length (mi)
Western	Southern UGB	SB	7.5	3.6	6.4	3.6
Southern UGB	Western	NB	6.7	3.6	6.3	3.6
Western	Chapman	SB	1.6	0.4	1.2	0.4
Chapman	Western	NB	1.2	0.4	1.1	0.4
Western	Hopkins	SB	2.3	0.6	1.8	0.6
Hopkins	Western	NB	1.7	0.6	1.6	0.6
Western	Richland	SB	3.7	1.2	2.9	1.2
Richland	Western	NB	3.0	1.2	2.8	1.2
Western	300' south of Goodnight	SB	4.6	1.6	3.7	1.6
300' south of Goodnight	Western	NB	3.8	1.6	3.6	1.6
Hospital	Southern UGB	SB	14.4	6.7	12.4	6.7
Southern UGB	Hospital	NB	13.6	6.7	12.1	6.7

In addition, the system-wide and project area measures of Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), average vehicle trip length, and total trips by mode were evaluated using CALM. For this purpose system-wide is defined as the Corvallis Urban Growth Boundary (UGB) and the project area remains the same delineation as originally established.

The VMT and VHT for both daily and the PM peak hour can be seen in Table 3.

**Table 3: Vehicle Miles Traveled and Vehicle Hours Traveled**

VMT	System Wide	Project Area
Daily	630,253	129,666
PM Peak	56,076	12,437
VHT	System Wide	Project Area
Daily	21,445	4,051
PM Peak	2,182	439

The average daily vehicle trip length is 8.8 minutes and the PM peak average vehicle trip length is 10.0 minutes. Additional documentation regarding this measure can be found in Appendix B.

The total trips by mode are identified in Table 4. The modes analyzed include auto, transit, bike, and walk. The auto mode is the only mode of the four that is available for the PM peak hour in addition to the daily aggregation.

**Table 4: Total Trips by Mode**

Mode	System Wide		Study Area	
	Daily	PM Peak	Daily	PM Peak
Auto	205,094	17,718	13,350	1,298
Transit	6,617	N/A	85	N/A
Bike	32,379	N/A	851	N/A
Walk	89,153	N/A	2,191	N/A

### Intersection Operational Standards

The study area falls within the Corvallis Area MPO (CAMPO) boundaries and the state jurisdiction operational standards used for the existing conditions will be guided by Table 6 of the Amended 2019 Oregon Highway Plan (OHP). The volume-to-capacity (v/c) ratio is used as a standard measure of intersection operations. The OHP mobility targets assist in the planning phase and help determine future system deficiencies so are used for current conditions as well as future no-build scenario. Each roadway classification will be compared to its appropriate standard from the OHP. Table 5 shows the OHP v/c ratio targets. The entire length OR 99W within the study area is classified as an OHP Regional Highway and an OHP Freight Route. The OHP has ODOT v/c considerations under Action 1.F.1 applying to the stopped non-state approaches. As stated in the OHP, meeting the targets in Table 5 “for the state highway approaches indicates that state mobility targets are being met. In order to maintain safe operation of the intersection, non-state highway approaches are expected to meet or not to exceed the volume to capacity ratios for District/Local Interest Roads” identified as 0.95 in Table 5.

**Table 5: State v/c Ratio Targets**

Roadway	v/c Targets
	OHP
Freight Route on a Regional or District Highway (MPO)	0.90
District/Local Interest Roads (MPO)	0.95

The City of Corvallis 2018 TSP, Chapter 6 identifies the mobility standard for facilities under City jurisdiction to be a maximum v/c ratio of 0.85. For signalized intersections, the combined intersection v/c ratio (not individual legs) must comply with the standard. For unsignalized intersections, all movements serving 20 vehicles per hour or more must comply with the standard. The Benton County 2018 TSP, Chapter 4 indicates that two-way stop and yield controlled intersections under County jurisdiction must operate with a v/c ratio not higher than 0.90. These v/c ratio standards are identified in Table 6.

**Table 6: City and County v/c Ratio Standards**

Roadway	v/c
<b>City of Corvallis</b>	
SW Western Blvd	0.85
SW B Ave	
SW Twin Oaks Cir/SE Chapman Pl	
SW Avery Ave/Crystal Lake Dr	
SE Alexander Ave	
SE Viewmont Ave	
SW Tunison Ave	
SE Richland Ave	
SE Park Ave	
SW Wake Robin Ave	
SE Goodnight Ave	
SW Goodnight Ave	
SE Rivergreen Ave	
<b>Benton County</b>	
OR 99W at Kiger Island Dr	0.90
OR 99W at Airport Ave	

***v/c Ratio and LOS***

Tables 7a and 7b show the v/c, LOS, and delay results for the unsignalized intersections in the study area. As noted in Tech Memo #9: Existing Conditions Volume Development Section, due to pandemic conditions it was not feasible to have traffic counts taken at all of the study area intersections. Table 7a presents the analysis results for intersections where historic counts were available. Table 7b presents analysis results for intersections where turn movement volumes were taken in April 2021 when COVID-19 traffic impacts were still present or where volumes were completely estimated due to lacking data. It is advisable to gather traffic counts and re-analyze these intersections when pandemic impacts are no longer present. All of the north-south major movements along OR 99W

except for at Twin Oaks/Chapman Place meet the OHP v/c target. Appendix E contains the Sidra intersection analysis results.

**Table 7a: Unsignalized Intersection v/c, LOS, & Delay**

Intersection <sup>1</sup>	v/c Threshold <sup>2</sup>	v/c <sup>3</sup>	LOS	Delay (sec)	Intersection Leg Reported
OR 99W &					
SE Park Ave	0.90 / 0.85	0.34 / 0.37	A / F	8 / 75	North / East
SW Wake Robin Ave	0.90 / 0.85	0.31 / <b>1.60</b>	A / F	6 / >120	South / West
SW Goodnight Ave	0.90 / 0.85	0.61 / 0.53	A / F	6 / 86	South / West

<sup>1</sup>Values for intersection are listed by MAJOR movement / MINOR movement.

<sup>2</sup>OHP mobility target for all MAJOR movements is 0.90; for all MINOR movements it is 0.95. The City of Corvallis mobility standard for these MINOR movements is 0.85.

<sup>3</sup>Black-shaded cells indicate that the OHP v/c target or the City or County standard has been exceeded.

**Table 7b: Estimated or COVID-19 Impacted Unsignalized Intersection v/c, LOS, & Delay**

Intersection <sup>1</sup>	v/c Threshold <sup>2</sup>	v/c <sup>3</sup>	LOS	Delay (sec)	Intersection Leg Reported
B Ave & 4 <sup>th</sup> St	0.90 / 0.85	0.34 / 0.61	A / E	3 / 35	North / East
B Ave & 3 <sup>rd</sup> St	0.90 / 0.85	0.25 / 0.38	A / E	3 / 40	South / West
OR 99W &					
Twin Oaks/Chapman Pl	0.90 / 0.85	<b>1.07 / &gt;2.0</b>	F / F	66 / >120	North / West
SE Viewmont Ave	0.90 / 0.85	0.34 / <b>&gt;2.0</b>	A / F	8 / >120	North / East
SW Tunison Ave	0.90 / 0.85	0.35 / <b>&gt;2.0</b>	A / F	8 / >120	North / West
SE Richland Ave	0.90 / 0.85	0.37 / <b>1.60</b>	A / F	8 / >120	North / East
SE Kiger Island Dr	0.90 / 0.90	0.32 / 0.07	A / C	5 / 19	North / East
SW Airport Ave	0.90 / 0.90	0.21 / 0.40	A / C	2 / 20	South / West

<sup>1</sup>Values for intersection are listed by MAJOR movement / MINOR movement.

<sup>2</sup>OHP mobility target for all MAJOR movements is 0.90; for all MINOR movements it is 0.95. The City of Corvallis mobility standard for these MINOR movements is 0.85. Benton County roadways have a mobility standard of 0.90.

<sup>3</sup>Black-shaded cells indicate that the OHP v/c target or the City or County standard has been exceeded.

The four unsignalized intersections of the OR 99W corridor with Wake Robin, SE Viewmont Avenue, SW Tunison Avenue, and SE Richland Avenue all exceed their respective v/c mobility targets due to the minor east-west movements. The intersection of OR 99W with Twin Oaks Circle/Chapman Place exceeds the mobility thresholds on both the major mainline movement as well as the east-west minor movement. The high v/c's are due to the difficulty in finding an acceptable gap to turn left onto the mainline.

SW Wake Robin Avenue, SE Viewmont Avenue, and SE Richland Avenue have all seen operational decline relative to existing conditions. This is due to a large increase in households assumed in South Corvallis in the Comprehensive Plan (approximately 1,500 households added between Alexander Avenue and Airport Avenue). A v/c greater than 1.0 indicates that the volume demand exceeds the available capacity of the roadway and that the area is highly congested. A v/c greater than 2.0 indicates that drivers are forced to accept much smaller gaps in mainline traffic which increases the risk of a collision.

At the Twin Oaks Circle/Chapman Place intersection, the mainline exceeds the OHP v/c target in 2040. This is due not only to an increase in volume assumed to occur in the future year, but also due to the nearby over-capacity signalized intersection at Crystal Lake Drive having an effect. Furthermore, existing conditions issues persist such as mainline northbound vehicles are often accelerating upon approaching the OR 34 on-ramp and also the mainline southbound traffic here is one of the highest peak hour volumes in the project study area. There is also a relatively high volume of bicyclists and pedestrians crossing the east leg of the intersection at Twin Oaks Circle/Chapman Place. These factors contribute to the high v/c and delay at this intersection.

It is particularly difficult to find an acceptable gap onto the mainline at the offset intersections of OR 99W with SE Viewmont Avenue and with SW Tunison Avenue due to their proximity. The issues created by the overlapping conflict zone (depicted in Figure 3) are discussed in detail in Tech Memo #9. Furthermore, the predominant movement from the side streets during the peak hour is northbound causing the larger movement out of SW Tunison Avenue to be a left turn while the larger movement at the intersection with SE Viewmont Avenue is a right turn.

**Figure 3: Overlapping Conflict Zone between Viewmont Avenue and Tunison Avenue**



Table 8 shows the signalized intersection results. Note that SE Goodnight Avenue and SE Rivergreen Avenue are assumed to be signalized in the future no-build scenario consistent with Corvallis TSP projects A10 and A11 (see Table 1). The intersections of OR 99W with SW Avery Avenue/Crystal Lake Drive and 4<sup>th</sup> Street with Western Boulevard exceed the v/c target. The issues at SW Avery Avenue/Crystal Lake Drive documented for the existing conditions are still present in the future no-build and have only been exacerbated by higher future volumes as well as the addition of a bike only phase (see Appendix C). While the diagonal bike-only phase offers significant benefits to the bicycle mode by allowing easy transit of the highway from the eastside multi-use path to the west side southbound bicycle lane, it does require all traffic movements to simultaneously be red for a phase. This drops the effective green time per cycle (g/c) ratio for the southbound movement thereby reducing the capacity and increasing delay. The high delay and reduced capacity present at SW Avery Avenue/Crystal Lake Drive are significant enough to create a bottleneck that extends through the interchange to impact operations at Western Boulevard & 4<sup>th</sup> Street. As mentioned previously and displayed in Figure 2, CALM identified this southbound section to already be at capacity causing unstable operations which experience a large impact when any additional delay is introduced to the system.

**Table 8: Signalized Intersection v/c, LOS, & Delay**

Intersection	v/c <sup>1</sup>	LOS	Delay (sec)
Western Blvd & 4 <sup>th</sup> St	1.23	F	>120
Western Blvd & 3 <sup>rd</sup> St	0.60	C	24
OR 99W & SW Avery Ave/Crystal Lake Dr	1.13	F	>120
OR 99W & SE Alexander Dr	0.54	C	20
OR 99W & SE Goodnight Ave	0.53	C	21
OR 99W & SE Rivergreen Ave	0.45	C	26

<sup>1</sup>Black-shaded cells indicate that the OHP v/c target of 0.90 highway or 0.95 local road or the City standard of v/c 0.85 has been exceeded. The most restrictive target or standard is applied to the intersection.

### ***95<sup>th</sup> Percentile Traffic Queuing***

The 95<sup>th</sup> percentile queues were obtained from the Sidra Intersection output. Figure 4 depicts the 95<sup>th</sup> percentile queues at the north end of the study area where the main queuing issues exist (the remainder of the study area has minimal queuing issues and the full set of study area queuing diagrams are available in Appendix E). Queuing issues seen in existing conditions have generally worsened.

Queuing issues present at both of the intersections of 3<sup>rd</sup> Street and 4<sup>th</sup> Street with Western Boulevard in existing conditions still exist but have worsened. The longer queues are due to higher volumes as well as queuing issues at intersections further to the south which are extensive enough to impact these intersections. There continues to be a

relatively high eastbound left turn movement at the intersection of 3<sup>rd</sup> Street and Western Boulevard and the left turn storage extends the entire length of the segment between 3<sup>rd</sup> Street and 4<sup>th</sup> Street in both directions. When the storage lane reaches capacity in the eastbound direction, it is difficult for southbound left movements to proceed at 4<sup>th</sup> Street. The storage lane in the westbound direction is frequently at capacity due to the extensive queuing southbound on 4<sup>th</sup> Street.

While the intersections of 3<sup>rd</sup> Street and 4<sup>th</sup> Street with SW B Avenue did not see significant queues in existing conditions due to the acceptance of shorter gaps to enter the mainline than would typically be assumed, there are queuing issues in future conditions. Similar to the queuing issues seen at the Western Boulevard intersections, the issues seen at the B Avenue intersections are worsened by the extensive queuing on SB 4<sup>th</sup> Street due to operational issues at areas to the south.

The southbound section of the couplet through the interchange ramps was identified as a congestion zone in the existing conditions. The southbound lanes change from three through lanes to two through lanes and an exclusive, trap-lane for right turns onto the westbound OR 34/US 20 on-ramp. Also as discussed earlier, CALM has identified this section to be at capacity (see Figure 2). Note that it is possible that queues through the interchange may not be completely stopped, but may demonstrate a slow moving, stop-and-go progression. Queues on SW Twin Oaks Circle and SE Chapman Place are delay-based as vehicles have difficulty finding gaps to either turn left onto OR 99W or to cross the highway.

The queues demonstrated at the intersection of OR 99W with SW Avery Avenue/SE Crystal Lake Drive are extensive and radiate to the north end of the study area. Not only have volumes increased, but also the existing signal cycle length, which was already relatively long in existing conditions at this intersection, has increased due to the addition of a diagonal bike only phase. This phase causes all other vehicular movement to stop. The effective green time per cycle ratio ( $g/c$ ) is reduced for all movements, causing longer queues. Also, in existing conditions some traffic uses Avery Avenue as a substitute for the missing eastbound OR 34/US 20 off-ramp to head southbound on OR 99W. It is likely that more trips will use this route as southbound congestion between Western Boulevard and Crystal Lake Drive increases, causing longer queues also on Avery Avenue.

The queuing near SE Alexander Avenue has only moderately increased in the future no-build scenario relative to existing conditions. Northbound queues on the south leg increased the most at this intersection. The queues on SE Viewmont Avenue and SW Tunison Avenue streets are delay-based as vehicles have difficulty in finding gaps to turn left onto OR 99W which has worsened due to an increase in volume. The north leg of SW Tunison Avenue demonstrates a substantial slowdown. As documented in Technical Memorandum #9, this type of intersection operation has the potential to increase the risk of rear end collisions so this intersection should be considered carefully as future mitigations are developed.

The intersections of OR 99W with SE Goodnight Avenue and SE Rivergreen Avenue are assumed to be signalized in the future no-build scenario consistent with Corvallis TSP projects A10 and A11 (see Table 1). As would be expected with the addition of a signal, queuing is now demonstrated where it was minimal or absent in the existing conditions. The remainder of the queues on the east and west cross streets in the southern section of the study area are generally limited to a vehicle or two at any one time and operations are not a concern at this time.

**Figure 4: 2040 95<sup>th</sup> Percentile Queues**

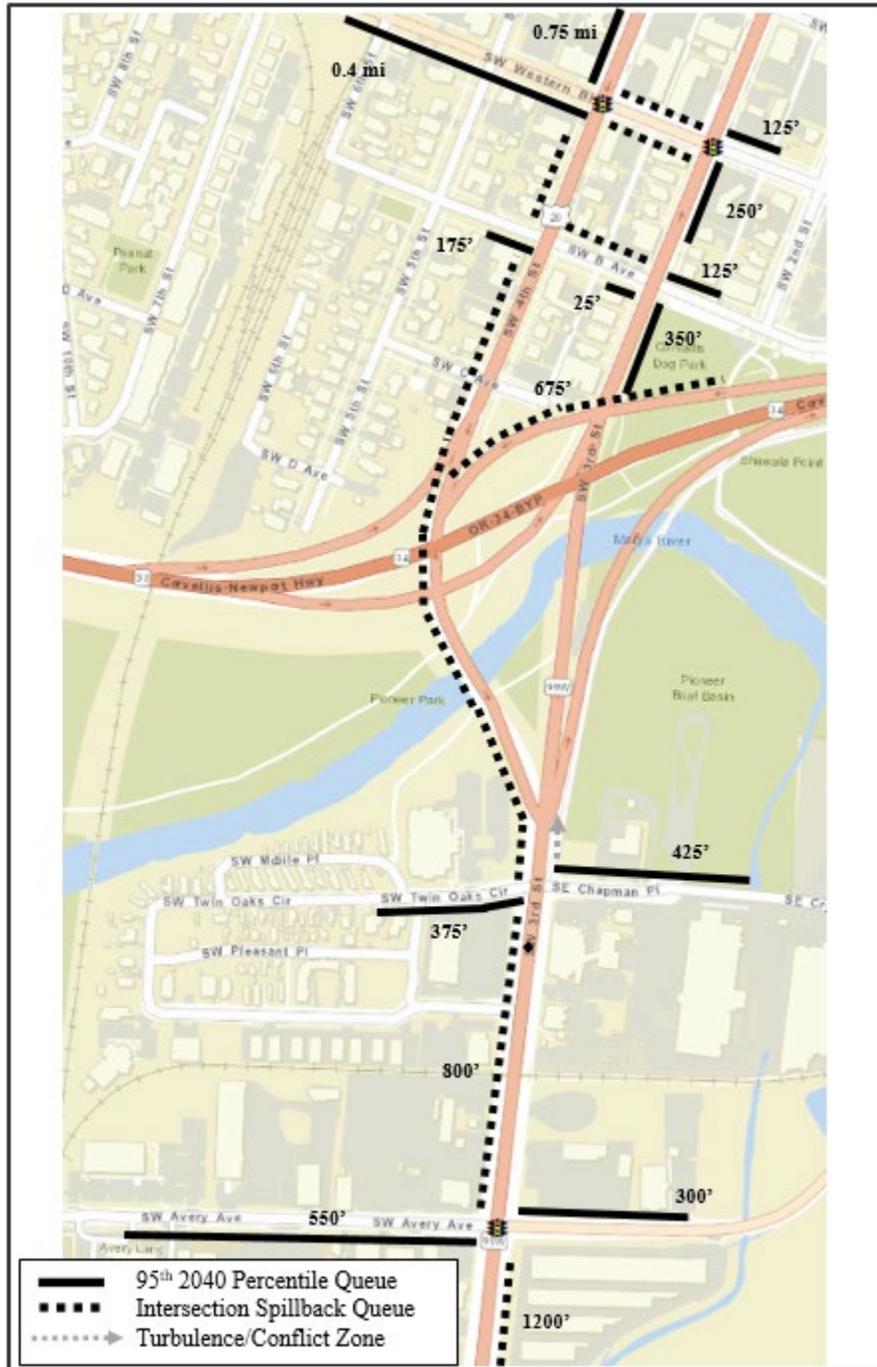


Figure 4: 2040 95<sup>th</sup> Percentile Queues, continued

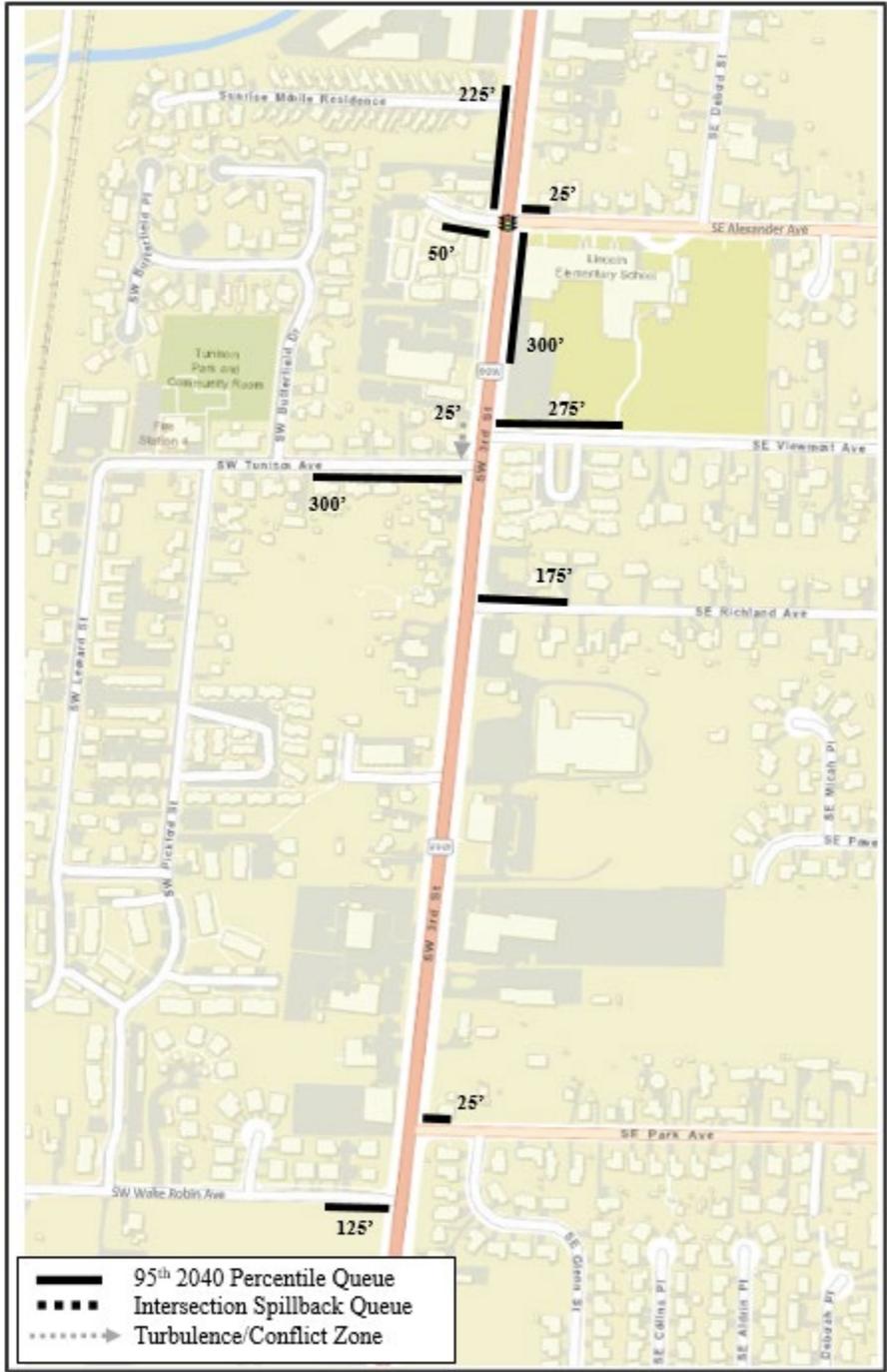


Figure 4: 2020 95<sup>th</sup> Percentile Queues, continued



## **Future No-build Deficiencies Summary**

The following is a summary of the future year study area deficiencies based on the analysis findings. These are areas that have been flagged for exceeding their respective mobility target, having a v/c ratio exceeding 1.0, or a delay-based LOS exceeding E, or for demonstrating extensive queuing:

- Nine out of the eleven unsignalized east-west roadways intersecting OR 99W throughout the study area have an LOS of E or worse. The two intersections with an LOS of C are at the extreme south end of the study area. This is predominantly due to the delay experienced when making a left turn onto the highway.
- The intersection of 4<sup>th</sup> Avenue & Western Boulevard and the intersections of OR 99W with Twin Oaks/Chapman Place and with Avery Avenue/Crystal Lake Drive are all over capacity with v/c's greater than 1.0.
- There is extensive queuing in the southbound direction beginning at Avery Avenue/Crystal Lake drive and extending to the north extent of the study area which significantly impacts the operations at all intersections in this section.
- While the installation of a diagonal bicycle only phase at signal at Avery Avenue/Crystal Lake Drive does provide significant safety benefits, it also reduces the g/c ratio for all traffic movements thereby increasing queues and reducing capacity.
- The intersections of SE Viewmont Avenue and SW Tunison with OR 99W are in very close proximity of each other (approximately 50 feet apart) which makes it more difficult for left turning traffic to use the TWLTL median as a refuge causing longer delays on these streets.
- The intersection of OR 99W with SW Tunison Avenue has a substantial slowdown in the southbound direction on the north leg due to reduced speeds for right turn movements. This type of intersection operations may be a safety concern and this intersection should be considered carefully upon potential mitigation development.