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MEMORANDUM

Date:	March 23, 2018	Project #: 21266.0
To:	Gerald Fisher and Dan Huff, City of Molalla Gail Curtis, Oregon Department of Transportation	
From:	Matt Bell and Nick Gross, Kittelson & Associates, Inc.	
Project:	Molalla Transportation System Plan (TSP) Update	
Subject:	Final Tech Memo 5: Future Needs Analysis (Subtask 3.6)	

This memorandum documents the existing and future transportation system needs within the city of Molalla. The information presented in this memorandum builds upon the gaps and deficiencies identified in *Tech Memo 4: Existing Transportation System* and provides the technical analysis needed to support the development of potential solutions that will be identified in *Tech Memo 6: TSP Solutions* This information is intended to inform the development of the city's 2018 Transportation System Plan (TSP) update which will address existing transportation system needs and additional facilities that are required to serve future growth. *Attachment "A" contains a menu of potential solutions that can be used to address many of the needs identified in this memo.*

PROJECTED LAND USES

Land use plays an important role in developing a comprehensive transportation system. The amount of land that is planned to be developed, the type of land uses, and how the land uses are mixed together all have a direct impact on how the transportation system will operate in the future. Understanding land use is critical to taking actions to maintain or enhance the transportation system.

Population and Household Forecast

Population data for Molalla was obtained from Portland State University's Population Research Center (PRC). The PRC's Coordinated Population Forecast for Clackamas County and areas within Urban Growth Boundaries (UGB) includes base year 2017 and forecast year 2035 and 2067 population estimates for the city of Molalla as well as estimates of persons per household. Based on the data, the population is currently 9,939 persons and is projected to be 15,841 persons in the year 2040; this reflects an Average Annual Growth Rate (AAGR) of approximately 2.2 percent per year between 2017 and 2035 and an AAGR of approximately 1.5 percent per year between 2035 and 2040. The persons per household is currently 2.8 and is projected to be 2.8 in 2040. Dividing the population data by 2.8 results in an estimated 3,550 households in 2017 and 5,658 households in the year 2040.

Employment Forecast

Employment data for Molalla was obtained from the draft Economic Opportunities Analysis (EOA) prepared by Johnson Economics. The data includes base year 2016 and forecast year 2036 employment estimates for six typologies, including office, institution, flex space/business park, industrial, warehouse, and retail. The EOA provides an estimated number of employees for each typology and an estimated acreage of employment space. Based on the data, there is currently 3,586 employees and 238.9 acres of employment space within Molalla and there is projected to be 6,295 employees and the need for 420.9 acres of employment space in the year 2040.

Table 1 summarizes the population and employment data for year 2017 and forecast year 2040 conditions. As shown, employment is expected to grow at a higher rate than the population over the 23-year period.

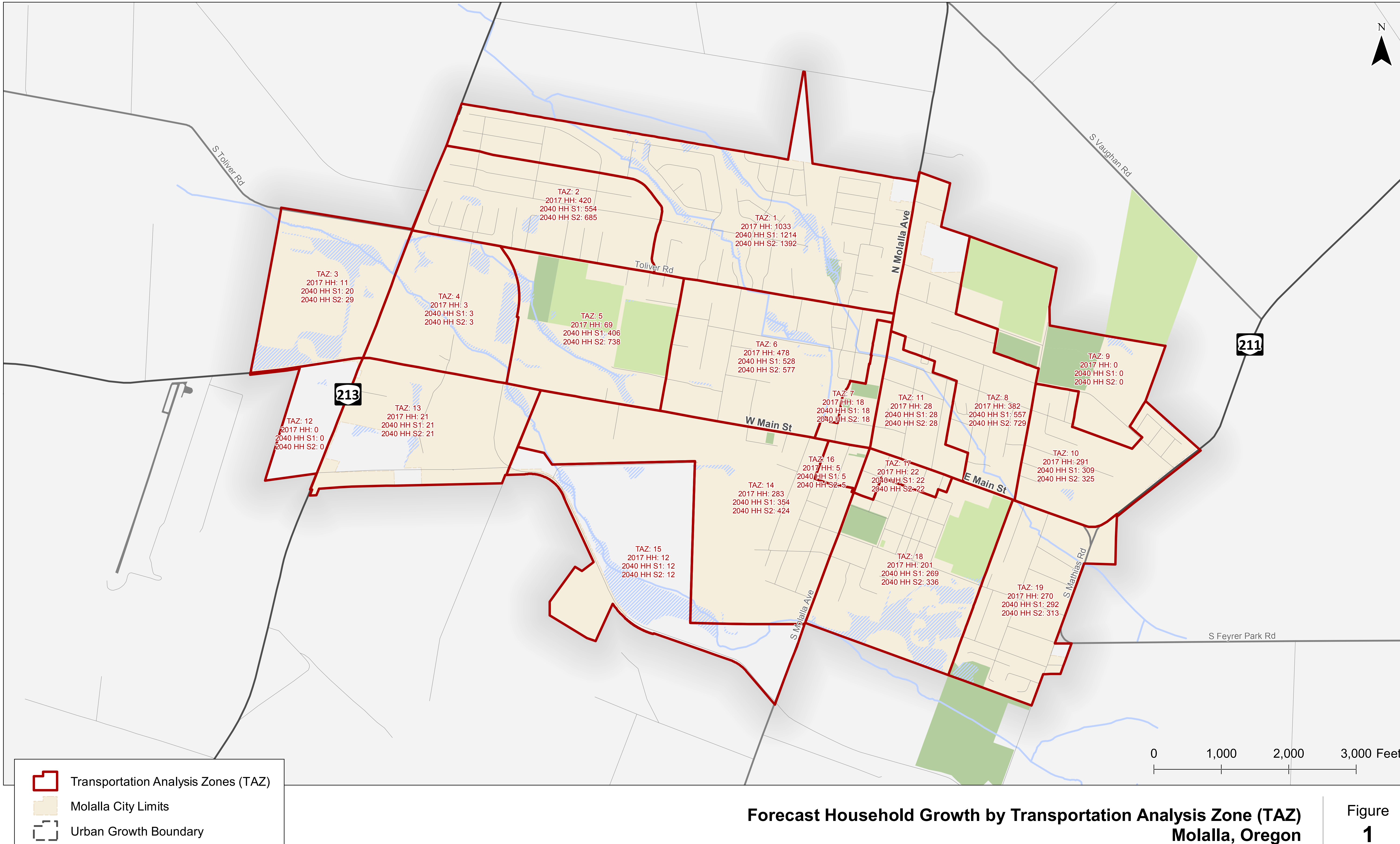
Table 1: Molalla Population and Land Use Summary

Land Use	2017	2040	Change	Annual Percent Change
Population	9,939	15,841	5,902	2.2%/1.5%
Households	3,550	5,658	2,108	2.2%/1.5%
Employment	3,586	6,295	2,709	3.3%
Acres	238.9	420.9	182.1	3.3%

The population and employment data shown in Table 1 was distributed throughout the City based on information provided in a recent Buildable Lands Inventory (BLI) prepared by Winterbrook Planning. The BLI identifies the amount of vacant land within the city and the type of households and employment uses that can be accommodated by the land based on the current comprehensive plan and zoning designations. Based on the BLI, the city cannot accommodate all the household and employment growth that is expected within the planning period without changes to current zoning designations, development patterns, and/or the UGB.

Given that the changes necessary to accommodate household and employment growth within the City are likely to occur within the planning horizon of the TSP, but following the development of the TSP Update, two land use scenarios were developed for the future conditions analysis: The first scenario reflects the level of development that can be accommodated within the City based on the current zoning designations and development patters; the second scenario reflects all the development associated with the population and employment growth; both scenarios reflect conditions within the current UGB. *Attachment "B" contains additional information on the population and employment forecasts as well as the scenarios developed for the future conditions analysis.*

Figures 1 and 2 illustrate the changes in households and employment (jobs) associated with each land use scenario by Transportation Analysis Zone (TAZ). The TAZs shown in Figures 1 and 2 were developed as part of the TSP Update based on the current zoning designations and the location of major roadways and intersections throughout the City. The TAZs provide a convenient way of evaluating and summarizing the population and household data for the City.



Forecast Household Growth by Transportation Analysis Zone (TAZ)
Molalla, Oregon

Figure
1

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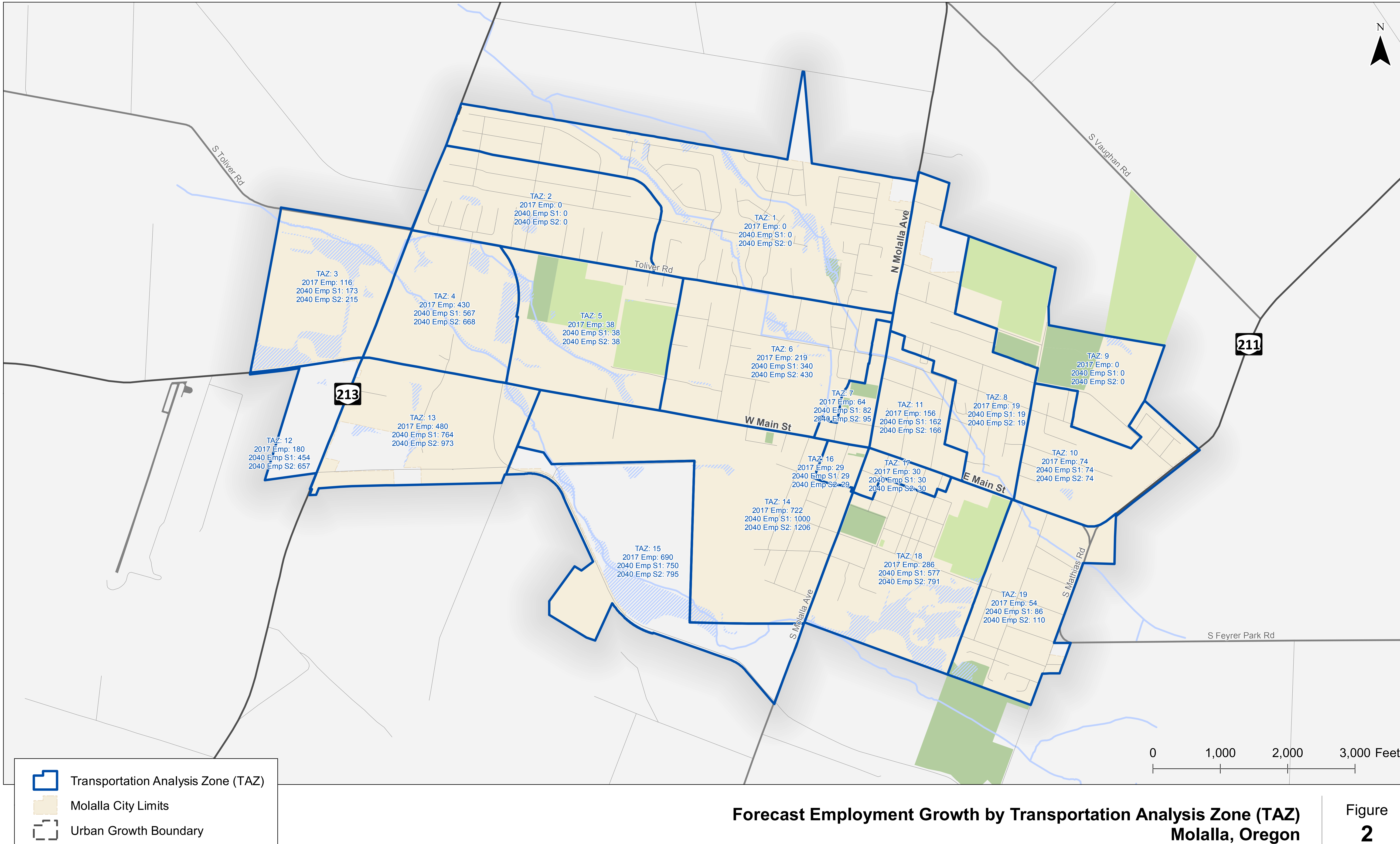
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla



Forecast Employment Growth by Transportation Analysis Zone (TAZ)
Molalla, Oregon

Figure
2

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Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

As land uses change in proportion to each other (i.e. there is a significant increase in employment relative to household growth), there will be a shift in the overall operation of the transportation system. Retail land uses generate a higher number of trips per acre of land than residential and other land uses. The location and design of retail land uses in a community can greatly affect transportation system operation. Additionally, if a community is homogeneous in land use character (i.e. all employment or all residential), the transportation system must support significant trips coming to or from the community rather than within the community. Typically, there should be a mix of residential, commercial, and employment type land uses so that some residents may work and shop locally, reducing the need for residents to travel long distances to meet these needs. The data shown in Table 1 indicates that significant growth is expected in Molalla in the coming years, particularly employment opportunities. The transportation system should be monitored to make sure that land uses in the plan are balanced with transportation system capacity.

PUBLIC TRANSIT SYSTEM NEEDS

Transit Level-of-Service Analysis

A transit level-of-service (LOS) analysis was conducted in accordance with the methodology described in *TCRP Report 100: Transit Capacity and Quality of Service Manual* (TCQSM). Chapter 3 of the TCQSM provides an extended discussion on quality of service, which is the evaluation of transit service from the passenger's point-of-view. The TCQSM uses six measures to quantify service quality. Each of these measures is assigned a letter value, where LOS A represents the best service from the passenger perspective and LOS F represents the worst service. *(Note that high LOS values, such as LOS A or B, may not reflect optimal service from the transit agency's perspective, because the market may not support those service levels. The development of agency service standards helps to bridge the gap between the kind of service passengers would ideally want and the kind of service that is reasonable to provide, given available resources.)* The transit LOS approach mirrors the system commonly used for streets and highways and allows a speedy comparison of service performance to transit passenger desires.

Of the six available measures, three were selected for this analysis as being most relevant to a long-range planning effort. Table 2 summarizes the TCQSM LOS measures used and the ranges of values used to determine the LOS result for each measure.

Table 2: TCQSM LOS Measures

Level of Service	Transit Capacity and Quality of Service Measures		
	Service Frequency (minutes)	Hours of Service	Service Coverage
LOS A	<10	19-24	90.0-100.0%
LOS B	10-14	17-18	80.0-89.9%
LOS C	15-20	14-16	70.0-79.9%
LOS D	21-30	12-13	60.0-69.9%
LOS E	31-60	4-11	50.0-59.9%
LOS F	>60	0-3	<50.0%

Service Frequency

From the user's perspective, *service frequency* determines how many times an hour a user has access to transit service, assuming that service is provided within acceptable walking distance (measured by *service coverage*) and at the times the user wishes to travel (measured by *hours of service*). Service frequency also measures the convenience of transit service to riders and is one component of overall transit trip time (helping to determine the wait time at a stop). Table 3 summarizes the transit LOS analysis results for service frequency.

Table 3: Service Frequency LOS Analysis

Provider	Routes	Service Frequency (minutes)	LOS
South Clackamas Transit District	Molalla City Bus[1]	60	E
	Molalla to Clackamas Community College[2]	45	E
	Molalla to Canby[1]	60	E

1. No service is provided on Saturday or Sunday.
2. Service is less frequent on Saturday.

As shown in Table 3, all three routes operate at LOS E. At this level, service is provided approximately once per hour and puts passengers in the position of potentially spending long periods of time waiting for service and/or rearranging schedules to be able to take transit.

Hours-of-Service

Hours of service, also known as "service span," is the number of hours during the day when transit service is provided along a route, a segment of a route, or between two locations. It plays as important a role as *frequency* and *service coverage* in determining the availability of transit service to potential users: if transit service is not provided at the time of day a potential passenger needs to take a trip, it does not matter where or how often transit service is provided the rest of the day. Table 4 summarizes the transit level-of-service analysis results for hours of service.

Table 4: Hours of Service LOS Analysis

Provider	Routes	Hours of Service	LOS
South Clackamas Transit District	Molalla City Bus[1]	10 hours	E
	Molalla to Clackamas Community College[2]	15 hours	C
	Molalla to Canby[1]	10 hours	E

1. No service is provided on Saturday or Sunday
2. Service is less frequent on Saturday.

As shown in Table 4, the Molalla City Bus and Molalla to Canby bus operate at LOS E while the Molalla to CCC bus operates at LOS C. At LOS E, service may be limited or non-existent during peak time periods and commuters may have limited choice of travel times. At LOS C, bus service runs only into the early evening, but still provides some flexibility in one's choice of time for the trip home.

Service Coverage

Service Coverage is a measure of the area within walking distance of transit service. Areas must be within 1/4-mile of a bus stop (or service route if there are no designated stops) or 1/2 mile of a transit station to be considered an area served by transit. As with the other availability measures, service coverage does not provide a complete picture of transit availability by itself, but when combined with frequency and hours of service, it helps identify the number of opportunities people have to access transit from different locations. Service coverage LOS evaluates the percentage of transit-supportive areas—areas that would typically produce the majority of a system's ridership—that are served by transit. To qualify as a transit-supportive area one of the following thresholds must be met:

- Minimum population density of 3 households/gross acre; or
- Minimum job density of 4 employees/gross acre.

Figure 3 illustrates the transit supportive areas and the transit supportive areas served by transit. Service coverage is an all-or-nothing issue for transit riders—either service is available for a particular trip or it is not. As a result, there is no direct correlation between service coverage LOS and what a passenger would experience for a given trip. Rather, service coverage LOS reflects the number of potential trip origins and destinations available to potential passengers. As noted in Table 2, at LOS A, 90 percent or more of the TSA's have transit service; at LOS F, less than half of the TSA's have service. Table 5 summarizes the transit level-of-service analysis results for service coverage.

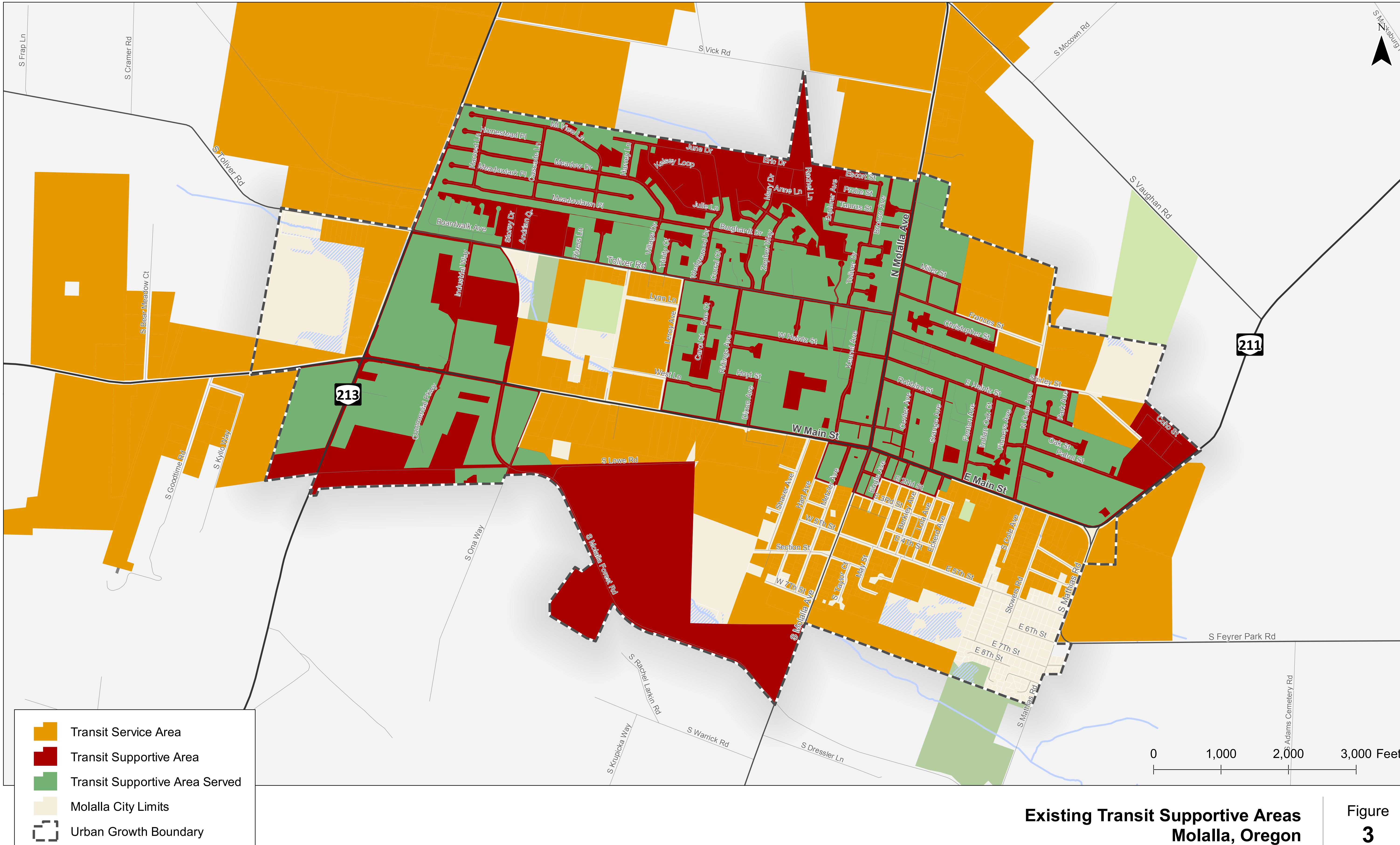
Table 5: Service Coverage LOS Analysis

Area Type	Population	Households	Employment
Transit Supportive Areas (TSA)[1]	7,603	2,713	2,371
Transit Supportive Areas Served[2]	4,888	1,744	1,155
Percent TSA Served by Transit	64%	64%	49%
Level of Service	D	D	F

1. Area shown in Green and red in Figure 3.
2. Area shown in Green in Figure 3.
3. Area shown in Green and orange in Figure 3.

Future Transit Service Coverage

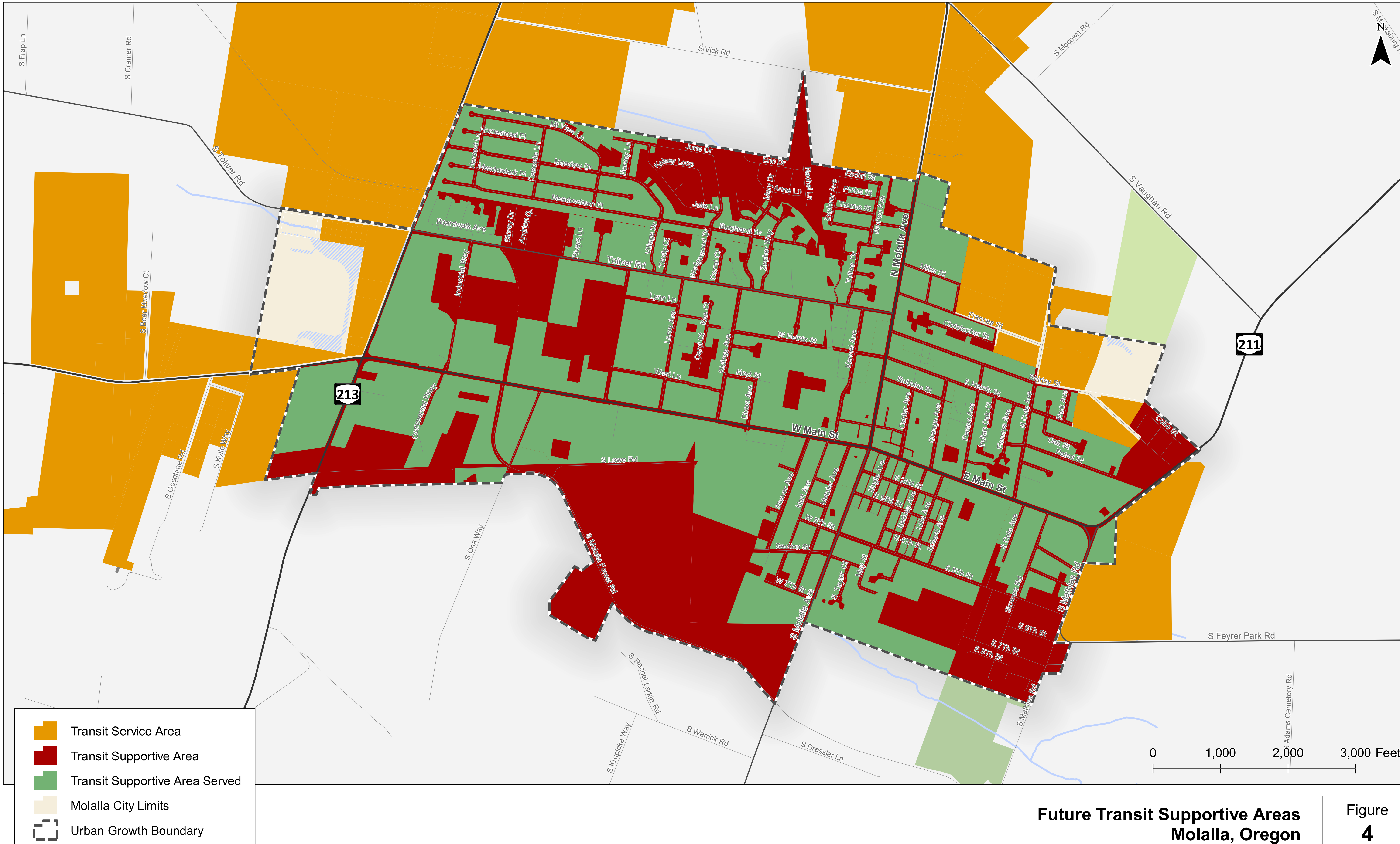
The future transit level-of-service analysis assumes that existing service frequencies, service hours, and service coverage is the same in the future. The only difference is the forecast population and employment growth result in additional transit supportive areas. Figure 4 displays the transit level of service analysis results for future transit service coverage. As shown, the number of transit supportive areas is expected to increase. While many of these areas are expected to be served by existing transit services, the remaining areas will require additional service routes or connections to existing routes in order to be served.



Existing Transit Supportive Areas
Molalla, Oregon

Figure
3

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla



Future Transit Supportive Areas
Molalla, Oregon

Figure
4

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Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

System Connectivity

The transit level of service analysis results indicate that transit service coverage is relatively high within the city, meaning that most people have access to public transit. However, there are a few areas where additional fixed-route service could be provided to improve access to transit as well as areas where existing service frequencies and hours of service could be increased to make public transit a more viable option for commuting.

Fixed-Routes

The areas shown in red in Figures 3 and 4 represent areas that support transit service under existing and/or future conditions but lack service. These areas could be served by providing new service or re-routing existing service along streets that currently do not provide service. The following provides a summary of the streets where transit service could be provided to address the need in these areas:

- Shirley Street from Cole Avenue to OR 211,
- OR 211 from Shirley Street to Mathias Road,
- Mathias Road from OR 211 to 5th Street, and
- 5th Street from Mathias Road to Swiegle Avenue.

Service along these streets would increase service coverage within the areas that currently support transit service, as well as the areas that are projected to support transit service in the future.

Transit Stops

Transit stop amenities such as signs, benches, shelters, and lighting can enhance transit service and make it more user-friendly. Amenities that make transit service as comfortable and accommodating as possible may help encourage ridership. South Clackamas Transportation District (SCTD) does not have guidelines for the types of transit infrastructure to include at stops; however, they do provide signs, benches, and shelters at select stop locations. Based on SCTDs current routes and schedules, which identifies specific stop locations, SCTD should consider signage and other amenities at the following locations:

- OR 213 at Meadow Drive (northbound)
- OR 213 at Toliver Road (northbound and southbound)
- OR 213/OR 211 (eastbound)
- OR 211 at Leroy Avenue (eastbound)
- OR 211 at Kennel Avenue (eastbound)

Park-and-Rides

Park-and-ride facilities provide parking for people who wish to transfer from their personal vehicle to public transportation or carpools/vanpools. Park-and-rides are frequently located near major intersections, at commercial centers, or on express and commuter bus routes. It is Oregon state policy to encourage the development and use of park-and-ride facilities at appropriate urban and rural locations adjacent to or within the highway right-of-way. Park-and-ride facilities can provide an efficient method to enhance access to transit service to and from low density areas, connecting people to jobs, and provide an alternate mode to complete long-distance commutes.

As indicated in *Tech Memo 4: Existing Transportation System,* there are currently no park and ride facilities located within Molalla. While the transit level of service analysis indicates that most people can access transit from their homes, a park and ride could encourage more people to routinely choose transit for their daily commute. Figure 5 illustrates the public transit system needs for Molalla.

Transportation Disadvantaged

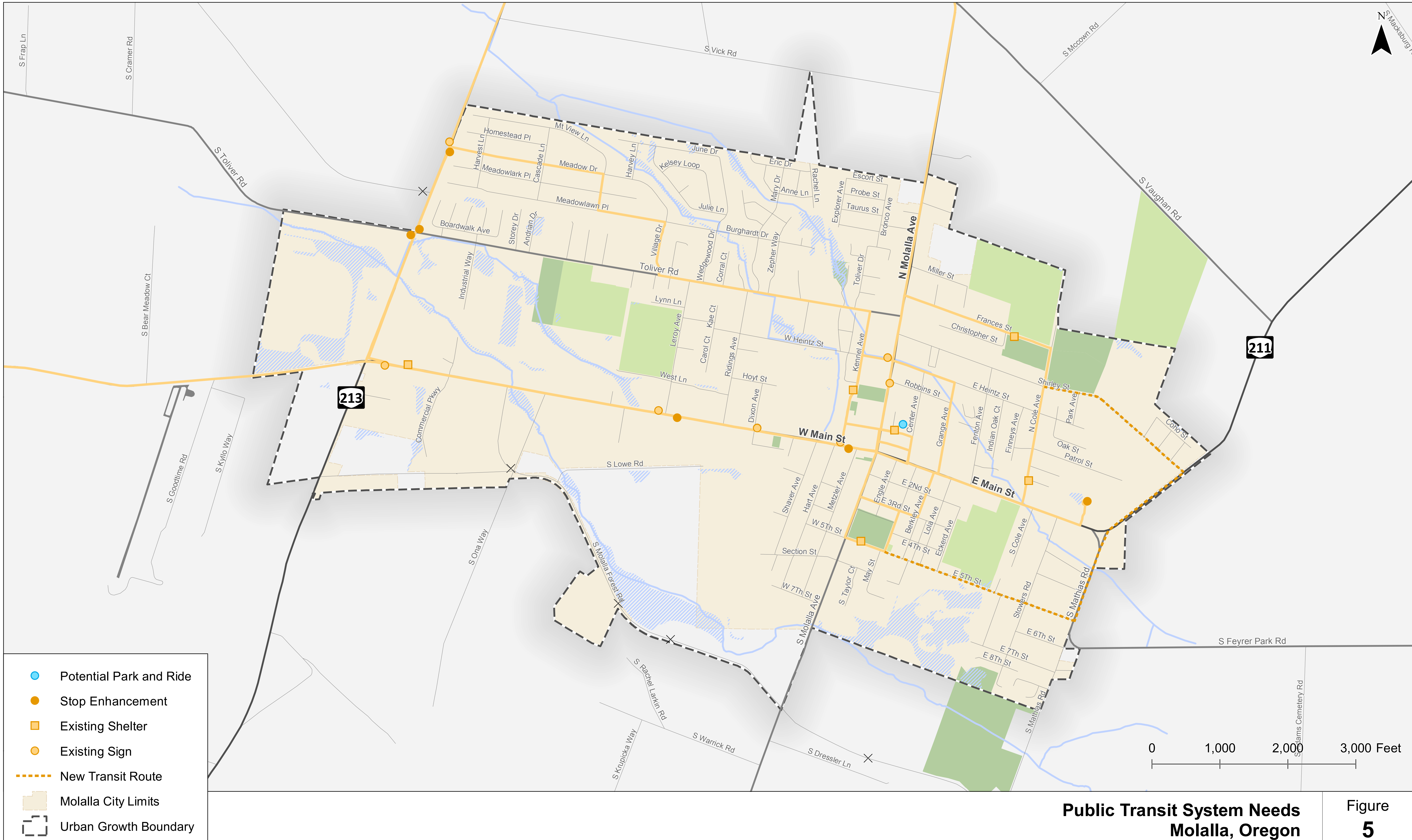
The primary transportation disadvantaged populations in Molalla include minorities, elderly people, youth, and people with low income (See *Tech Memo 4: Existing Transportation System* for additional information on the location and concentration of these populations in Molalla). These populations rely on the public transit system to meet daily needs, including access to schools, parks, churches, and other essential destinations throughout the City. The City of Molalla should continue to support SCTD and Clackamas County in their efforts to provide services to these populations. Also, because the needs of these populations are expected to increase, Molalla should work with service providers to assess the needs and develop ways to best meet them.

PEDESTRIAN SYSTEM NEEDS

Pedestrian facilities, such as sidewalks, shared-use paths, off street trails, as well as marked and unmarked, signalized and unsignalized pedestrian crossings are essential elements of the city’s pedestrian system. While these facilities are currently provided along many city streets, there are many more streets where these facilities are needed to improve pedestrian access and connectivity. The following provides a summary of the pedestrian system needs within Molalla, which is based on the gaps and deficiencies identified in *Tech Memo 4: Existing Transportation System* and a system-level analysis of the pedestrian facilities located along arterial and collector streets. As described below, the most common overall need is to provide a safe and interconnected pedestrian system that encourages people to walk, especially for trips less than one-half mile in length.

Pedestrian Level of Traffic Stress Analysis

The pedestrian facilities located along the city’s arterial and collector streets were evaluated in an effort to identify potential issues that could be addressed as part of the TSP update. The Oregon Department of Transportation (ODOT) Analysis Procedures Manual (APM) provides a methodology for evaluating pedestrian facilities within urban and rural environments called Pedestrian Level of Traffic Stress (PLTS). As applied by ODOT, this methodology classifies four levels of traffic stress that a pedestrian can experience on the roadway, ranging from PLTS 1 (little traffic stress) to PLTS 4 (high traffic stress). A road segment that is rated PLTS 1 generally has low traffic volumes and travel speeds and has sidewalks that are separated from vehicular traffic. These segments are generally suitable for all users, including children. A road segment that is rated PLTS 4 generally has high traffic volumes and travel speeds and is perceived as unsafe by most adults. Road segments rated PLTS 4 also include those with no sidewalks or other pedestrian facilities. Per the APM, PLTS 2 is considered a reasonable target for most pedestrian facilities due to its acceptability for the majority of people.



Public Transit System Needs
Molalla, Oregon

Figure
5

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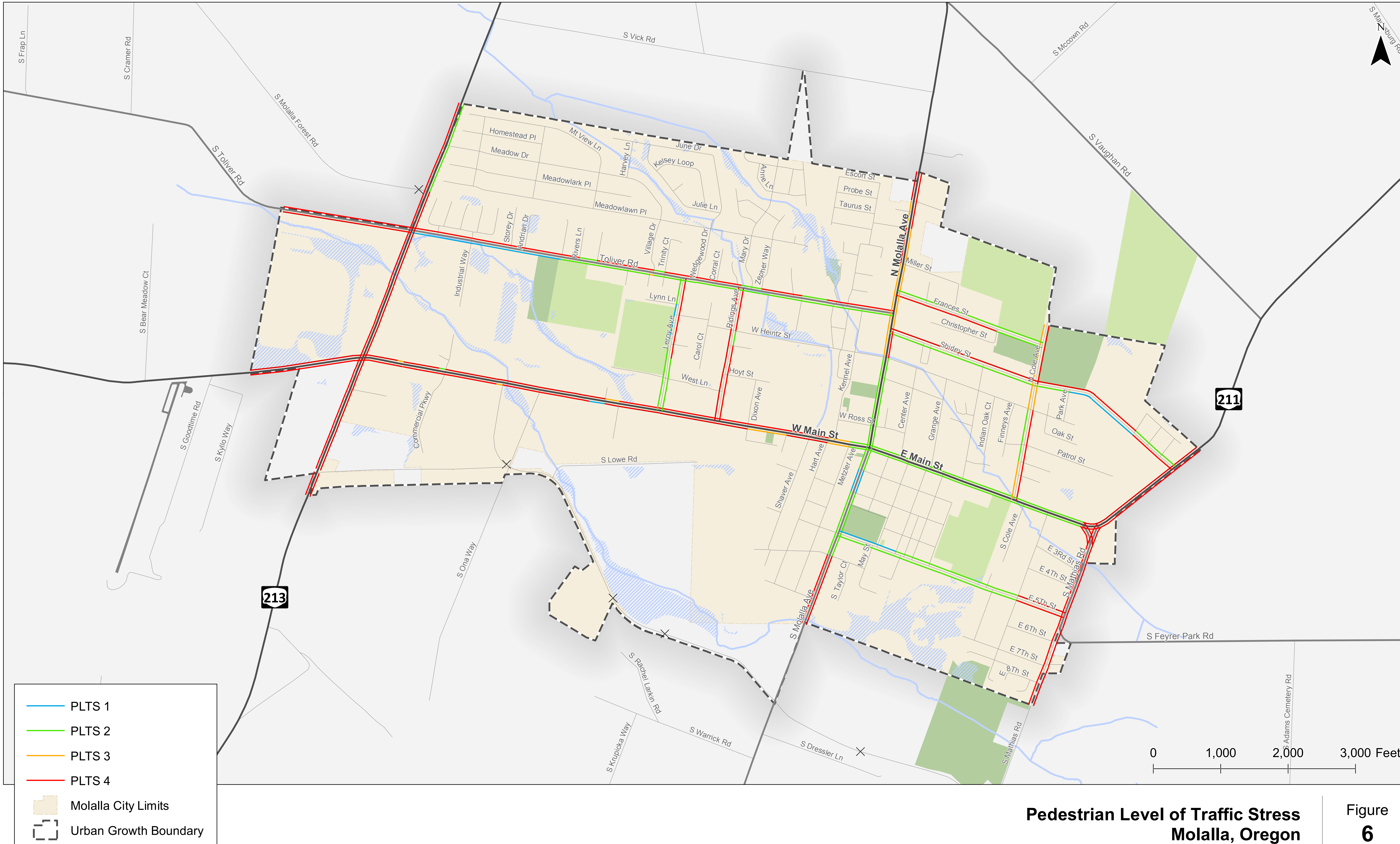
Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

The PLTS score is based on four criteria, including sidewalk condition, physical buffer type, total buffering width, and general land use. All four criteria are scored from 1 to 4 and the highest score determines the overall score for the road segment. Figure 6 illustrates the results of the PLTS analysis for Molalla's arterial and collector streets. It is important to note that while some segments are shown as PLTS 3 or 4, they may have shorter segments with lower PLTS scores. Table 6 summarizes the detailed results of the PLTS analysis, which includes the scores for each criterion.

As shown, there are 19 road segments rated PLTS 3 and 25 road segments rated PLTS 4. A majority of the roadway segments rated PLTS 3 have sidewalks in poor-to-fair conditions and are less than five feet wide. In order for these segments to be rated PLTS 2, the sidewalks in poor condition would need to be reconstructed and widened to a minimum of six feet when curb tight, or five feet when separated, whereas the sidewalks in fair condition would only require widening. A smaller number of roadway segments are also rated PLTS 3 due to having curb tight sidewalks on roadways with a posted speed limit of 30 mph or higher. In order for these segments to be rated PLTS 2, the posted speed limit would need to be reduced to 25 mph or a physical buffer would need to be installed between the sidewalk and the vehicle travel lane.

The majority of segments rated PLTS 4 have no sidewalks or other pedestrian facilities to accommodate pedestrians. Additionally, the majority of sidewalk segments along OR 213 and OR 211 are curb tight with a posted speed between 25 - 45 mph resulting in a rating of PLTS 4. *Attachment "C" contains detailed information on the PLTS analysis results.*



Pedestrian Level of Traffic Stress
Molalla, Oregon

Figure
6

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

Table 6: PLTS Analysis Results

Street	From	To	Side	Pedestrian LTS Criteria Scores				Pedestrian LTS
				Sidewalk Condition	Physical Buffer Type	Total Buffering Width	General Land Use Criteria	
Arterial								
OR 213	City Limits (north)	Meadow Drive	East	2	2	1	1	2
	Meadow Drive	S Molalla Road	East	2	2	1	1	2
	S Molalla Road	Toliver Road	N/A	N/A	N/A	N/A	1	4
	Toliver Road	31275 OR 213	N/A	N/A	N/A	N/A	1	4
	31275 OR 213	31288 OR 213	West	1	4	2	3	4
	31290 OR 213	OR 211	East	1	4	2	2	4
	OR 211	31600 OR 213	East	3	4	4	2	4
	31600 OR 213	City Limits (south)	31600 OR 213	N/A	N/A	2	1	4
OR 211	City Limits (east)	OR 213	N/A	N/A	N/A	N/A	1	4
	OR 213	12700 OR 211	Both	1	3	4	3	4
	12700 OR 211	1524 W Main Street	North	1	3	3	2	3
	1524 W Main Street	1400 Fountain Way	N/A	N/A	N/A	N/A	2	4
	1400 Fountain Way	Industrial Way	North	1	1	2	2	2
	Industrial Way	12966 OR 211	N/A	N/A	N/A	N/A	1	4
	12966 OR 211	Molalla Forest Road	South	1	3	2	1	3
	Molalla Forest Road	872 W Main Street	N/A	N/A	N/A	N/A	1	4
	872 W Main Street	N Hezzie Lane	South	1	1	1	1	1
	N Hezzie Lane	805 W Main Street	North	3	3	3	1	3
	805 W Main Street	Leroy Avenue	N/A	N/A	N/A	N/A	2	4
	Leroy Avenue	701 W Main Street	North	4	2	2	1	4
	701 W Main Street	631 W Main Street	Both	3	3	2	1	3
	631 W Main Street	Thelander Lane	South	1	3	3	2	3
	Thelander Lane	304 W Main Street	N/A	N/A	N/A	N/A	2	4
	304 W Main Street	Metzler Street	Both	3	2	2[3]	2	3
	Metzler Street	Molalla Avenue	Both	2	2	2[3]	2	2
	Molalla Avenue	Lola Street	Both	2	2	2[3]	2	2

	Lola Street	N Cole Avenue	Both	2	1	2[3]	1	2
	N Cole Avenue	810 E Main Street	Both	2	1	2[3]	1	2
	810 E Main Street	City Limits (east)	N/A	N/A	N/A	N/A	1	4
Molalla Avenue	City Limits (north)	Church Street	N/A	N/A	N/A	N/A	1	4
	Church Street	Thunderbird Street	West	2	3	2	1	3
	Thunderbird Street	Miller Street	East	3	1	2	1	3
	Miller Street	E Francis Street	Both	3	1	2	1	3
	E Francis Street	Toliver Road	Both	3	1	2	1	3
	Toliver Road	527 Molalla Avenue	Both	3	1	2	1	3
	527 Molalla Avenue	E Heintz Street	West	3	1	2	2	3
	E Heintz Street	OR 211	Both	1	2	2[3]	2	2
	OR 211	E 2nd Street	Both	1	2	2[3]	2	2
	E 2nd Street	E 3rd Street	Both	1	1	1[3]	1	1
	E 3rd Street	E 6th Street	Both	2	1	2[3]	1	2
	E 6th Street	614 Molalla Avenue	Both	3	1	2[3]	1	3
	614 Molalla Avenue	City Limits (south)	N/A	N/A	N/A	N/A	1	4
Major Collectors								
Meadow Drive	OR 213	Harvest Lane	Both	2	2	2[3]	1	2
	Harvest Lane	Cascade Lane	Both	3	2	2[3]	1	3
	Cascade Lane	Harvey Lane	Both	3	2	2[3]	1	3
	Harvey Lane	Meadowlawn Place	Both	2	2	2[3]	1	2
	Meadowlawn Place	Toliver Road	Both	3	2	2[3]	1	3
Toliver Road	City Limits (west)	OR 213	North	N/A	N/A	N/A	1	4
	City Limits (west)	1700 Toliver Road	South	1	4	2	1	4
	1700 Toliver Road	OR 213	South	N/A	N/A	N/A	1	4
	OR 213	Industrial Way	South	1	1[4]	1[3]	1	1
	Industrial Way	Molalla Forest Road	South	1	1[4]	1[3]	1	1
	Molalla Forest Road	1015 Toliver Road	Both	1	1[4]	1[3]	1	1
	1015 Toliver Road	Zimmerman Lane	South	1	1[4]	1[3]	1	1
	Zimmerman Lane	905 Toliver Road	South	2	2	2[3]	1	2
	905 Toliver Road	Kalugin Court	Both	2	2	2[3]	1	2
	Kalugin Court	Village Drive	South	2	2	2[3]	1	2
	Village Drive	800 Trinity Court	Both	2	2	2[3]	1	2
	800 Trinity Court	Ridings Avenue	South	2	2	2[3]	1	2

	Ridings Avenue	Zephyr Way	Both	2	2	2[3]	1	2
	Zephyr Way	Pegasus Court	South	2	2	2[3]	1	2
	Pegasus Court	31 Toliver Road	Both	2	2	2[3]	1	2
	31 Toliver Road	Molalla Avenue	South	2	2	2[3]	1	2
Shirley Street	Molalla Avenue	101 Shirley Street	Both	2	2	2[3]	1	2
	101 Shirley Street	Fenton Street	South	2	2	2[3]	1	2
	Fenton Street	N Cole Avenue	South	2	2	2[3]	1	2
	N Cole	321 E Park Avenue	South	2	2	2[3]	1	2
	321 E Park Avenue	300 Steelhead Street	South	1	1	1[3]	1	1
	300 Steelhead Street	301 Steelhead Street	Both	1	1	1[3]	1	1
	301 Steelhead Street	OR 211	South	N/A	N/A	N/A	N/A	4
Leroy Avenue	Toliver Road	Lynn Lane	West	1	2	2	1	2
	Lynn Lane	Skye Lane	West	1	1	1	1	1
	Skye Lane	209 Leroy Avenue	West	1	2	2	1	2
	209 Leroy Avenue	OR 211	Both	2	2	2	1	2
	Toliver Road	209 Leroy Avenue	East	N/A	N/A	N/A	1	4
E 5th Street	Molalla Avenue	Berkley Avenue	North	1	1	1[3]	1	1
	Molalla Avenue	May Street	South	2	1	2	1	2
	May Street	Berkley Avenue	South	2	2	2	1	2
	Berkley Avenue	Stower Road	Both	2	2	2[3]	1	2
	Stower Road	S Mathias Road	N/A	N/A	N/A	N/A	1	4
Minor Collectors2								
Frances Street	Molalla Avenue	Debra Street	North	2	2	2	1	2
	Debra Street	N Cole Avenue	Both	2	2	2	1	2
Ridings Avenue	Toliver Road	Heintz Street	Both	N/A	N/A	N/A	1	4
	Heintz Street	Prince Court	East	1	2	2	1	2
	Heintz Street	Prince Court	West	N/A	N/A	N/A	1	4
	Prince Court	OR 211	Both	N/A	N/A	N/A	1	4
N Cole Avenue	Frances Street	Shirley Street	West	3	2	2	1	3
	Shirley Street	Heintz Street	Both	3	1	2	1	3
	Heintz Street	207 N Cole Street	Both	2	2	2[3]	1	2
	207 N Cole Avenue	Patrol Street	West	2	2	2[3]	1	2
	Patrol Street	151 N Cole Avenue	West	2	2	2[3]	1	2
	151 N Cole Avenue	127 N Cole Avenue	Both	3	3	2[3]	1	3

	127 N Cole Avenue	OR 211	West	4	3	2[3]	1	4

Shaded cells segments that do not meet the LTS 2 target.
* The effective width of the pedestrian facility is greater than 6 feet. The LTS value is from the last line of the sidewalk condition criteria table in the APM.
[1] No illumination present. LTS degraded by one unless already at LTS 4.
[2] Segment located on a bridge. LTS improved to LTS 3.
[3] Existing non-striped parking. Assume parking area is six to eight feet wide.
[4]Shared-use Path

System Connectivity

A well-connected pedestrian system provides continuous sidewalks and other pedestrian facilities between essential destinations, such as residential neighborhoods, schools, parks, and retail/commercial centers. Strategies to improve pedestrian connectivity include identifying, prioritizing, and ultimately constructing new sidewalks, shared-use paths and trails, pedestrian crossings, and connections between neighborhoods. The following provides a summary of connectivity needs for the pedestrian system.

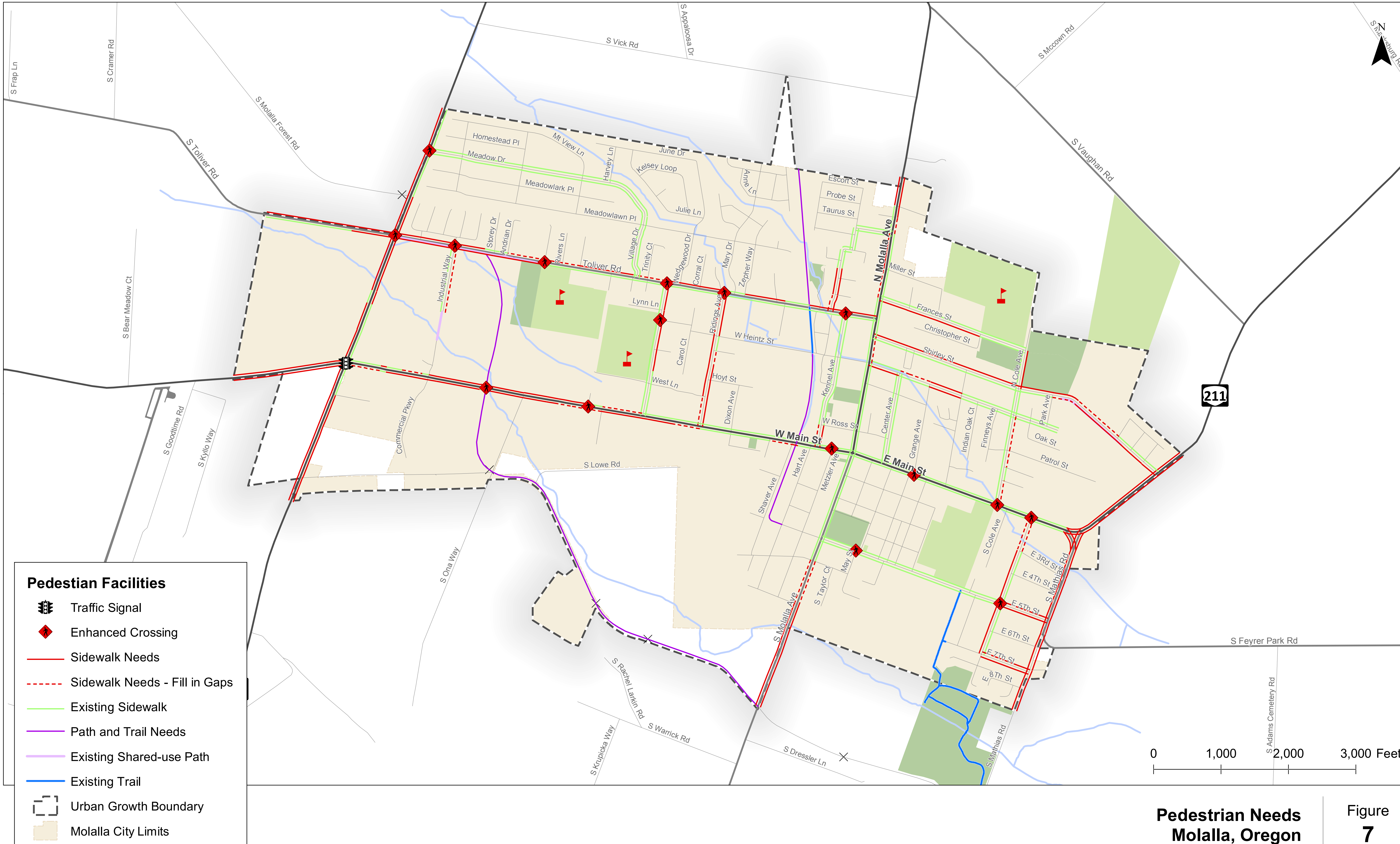
Sidewalks

As indicated in *Tech Memo 4: Existing Transportation System* and in the PLTS analysis described above, there are several arterial and collector streets that need new sidewalks or updates to existing sidewalks and other pedestrian facilities to improve connectivity. Figure 7 illustrates the pedestrian system needs within Molalla. The following summarizes the arterial and collector streets where there is a need to fill in the gaps in the existing sidewalk network or install new sidewalks along one or two sides of the roadway:

- 5th Street between Stowers Road and Mathias Road – install sidewalks on both sides
- Cole Avenue between OR 211 and Frances Street – fill in gaps on east side
- Frances Street between N Molalla Avenue and Cole Avenue – fill in gaps on south side
- Leroy Avenue between Toliver Road and OR 212 – fill in gaps on east side
- Mathias Road between south city limits and OR 211 – install sidewalks on both sides
- N Molalla Avenue between Heintz Street and north city limits – fill in gaps on both sides
- S Molalla Avenue between 5th Street and south city limits – fill in gaps on both sides
- OR 211 between the west city limit and OR 213 – install sidewalks on both sides
- OR 211 between OR 213 and N Molalla Avenue –fill in gaps on both sides
- OR 211 between Mathias Road and Shirley Street – install sidewalks on both sides
- OR 213 between south city limit and OR 211 – fill in gaps on both sides
- OR 213 between OR 211 and north city limit – fill in gaps on both sides
- Shirley Street between N Molalla Avenue and OR 211 – fill in gaps on both sides
- Ridings Avenue between OR 211 and Toliver Road – fill in gaps on both sides
- Toliver Road between west city limits and OR 213 – fill in gaps on both sides
- Toliver Road between OR 213 and N Molalla Avenue – fill in gaps on north side

In addition to the arterial and collector streets, there are several neighborhood route and local streets that have been identified in previous planning documents as serving a critical need for local residents. The following summarizes the streets where there is a need to fill in the gaps in the existing sidewalk network or install new sidewalks along one or two sides of the streets:

- 2nd Street between S Molalla Avenue and Eckerd Avenue – fill in gaps on both sides
- 3rd Street between S Molalla Avenue and Eckerd Avenue – fill in gaps on both sides
- 4th Street between S Molalla Avenue and Eckerd Avenue – fill in gaps on both sides



Pedestrian Needs
Molalla, Oregon

Figure
7

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KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

- 7th Street between Stowers Road and Mathias Road – install sidewalks on both sides
- 7th Street between Metzler Road and S Molalla Avenue – install sidewalks on both sides
- Fenton Street between OR 211 and Shirley Street – fill in gaps on both sides
- Grange Avenue between OR 211 and Heintz Street – fill in gaps on the eastern side
- Heintz Street from N Molalla Avenue to Cole Avenue - fill in gaps on both sides
- Industrial Way from Toliver Road to southern terminus – fill in gaps on the east side
- Kennel Avenue from OR 211 to Ross Street – fill in gaps on both sides
- Metzler Street between OR 211 and 7th Street – fill in gaps on both sides
- Stowers Road between OR 211 and 7th Street – fill in gaps on both sides

The following provides a summary of the general needs associated with sidewalks within Molalla:

- Lighting is needed along roadways where light levels are inconsistent with City standards.
- Wider sidewalks are needed where curb tight sidewalks are less than six feet wide and where sidewalks with landscape strips are less than five feet.
- New sidewalks or repairs to existing sidewalks are needed where sidewalk conditions are poor or very poor.
- Physical buffers are needed adjacent to roadways without on-street bike lanes or on-street parking lanes and when vehicle speeds are equal to or greater than 35 mph.

Pedestrian Crossings

Pedestrian crossings along the city's arterial and collector streets are limited to major intersections and a few key mid-block crossing locations near pedestrian destinations. There is one marked pedestrian crossing along OR 213 at the intersection of OR 213 and OR 211 that includes pedestrian push buttons and pedestrian signal heads. There are several unsignalized pedestrian crossings along OR 211, most notably within the Special Transportation Area (STA) between Hart Avenue and Grange Avenue. Unsignalized pedestrian crossings are also consistently provided along Molalla Avenue from Shirley Street to E 3rd Street. However, there are several additional locations where marked pedestrian crossings are needed to provide connectivity as well as access to schools, parks, and other essential destinations within the city. The following summarizes the additional pedestrian crossing needs:

- Enhanced pedestrian crossing at OR 213 and Meadow Drive
- Enhanced pedestrian crossing at OR 213 and Toliver Road
- Enhanced pedestrian crossing at OR 211 and Molalla Forest Road
- Enhanced pedestrian crossing at OR 211 and N Hezzie Lane
- Enhanced pedestrian crossing at OR 211 and Metzler Avenue
- Enhanced pedestrian crossing at OR 211 and Grange Avenue
- Enhanced pedestrian crossing at OR 211 and Cole Avenue
- Enhanced pedestrian crossing at OR 211 and Stowers Road

- Enhanced pedestrian crossing at Toliver Road and Industrial Way
- Enhanced pedestrian crossing at Toliver Road and Zimmerman Lane
- Enhanced pedestrian crossing at Toliver Road and Leroy Avenue
- Enhanced pedestrian crossing at Toliver Road and Ridings Avenue
- Enhanced pedestrian crossing at Toliver Road and Kennel Avenue
- Enhanced pedestrian crossing at 5th Street and May Street
- Enhanced pedestrian crossing at 5th Street and Stowers Road
- Enhanced pedestrian crossing at Leroy Avenue and Heintz Street

Figure 7 also illustrates the locations of the crossing needs. An enhanced pedestrian crossing at each of these locations would improve connectivity along the roadways as well as access to essential destinations.

Shared-Use Paths and Trails

Shared-use paths and trails are designated pathways for cyclists and pedestrians. As indicated in *Tech Memo 4: Existing Transportation System*, there are several shared-use paths and trails located throughout the City of Molalla. The segment of Molalla Forest Road from Toliver Road to OR 211 is an unimproved shared-use path that provides connectivity for non-motorized users. Access to the path is provided at Toliver Road and OR 211 although the entrance at OR 211 is constrained due to the overgrowth of shrubbery. Improving this segment and developing a new segment from OR 211 to Mathias Road would provide an enhanced east-west connection for pedestrians and bicyclists and help support healthy transportation options within Molalla. The segment of the Molalla Western Railway spur line located between Toliver Road and Heintz Street is another unimproved shared-use path that provides connectivity for non-motorized users. Improving this segment and developing a new segment along the former Molalla Western Railway spur line from Toliver Road to the north city limits and from Heintz Street to 5th Street would provide an enhanced north-south connection for pedestrian and bicyclists. The following summarizes the shared-use paths and trail needs within Molalla:

- Shared-use path along Molalla Forest Road from Toliver Road to OR 211.
- Shared-use path along Molalla Forest Road from OR 211 to Mathias Road.
- Shared-use path along the Molalla Western Railway line from north city limits to OR 211.
- Shared-use path along the Molalla Western Railway line from OR 211 to E 5th Street.

Pedestrian Accessways

Connections between cul-de-sacs and adjacent roadways can significantly reduce travel distances for pedestrians, thereby, encouraging more people to walk. Appropriate improvements should provide for more direct, convenient, and safe bicycle and pedestrian travel within and between residential areas and neighborhood activity centers. Molalla has a few accessways that create connections between neighborhoods and pedestrian and bicycle routes. Additional accessways are not always possible due to topography and existing development patterns. However, The City should identify opportunities for future accessways and require developers to install accessways along with future development.

BICYCLE SYSTEM NEEDS

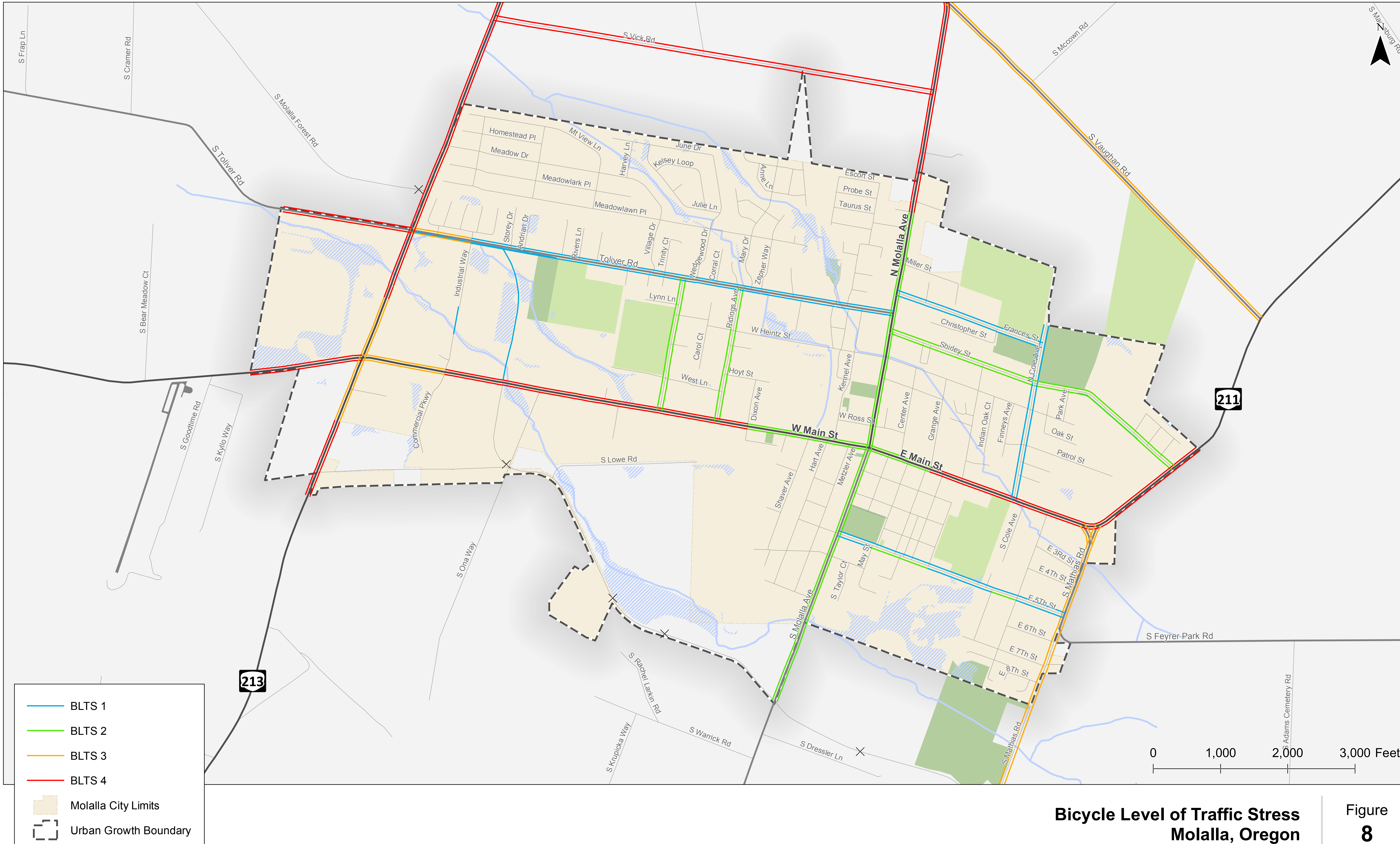
Bicycle facilities, such as on-street bike lanes, shoulder bikeways, shared roadway pavement markings/signs, bicycle parking, and wayfinding signage are essential elements of the city's bicycle system. While these facilities are currently provided along a few city streets, a majority of city streets are in need of these facilities to improve bicycle access and connectivity. The following provides a summary of the bicycle system needs within Molalla, which are based on the gaps and deficiencies identified in *Tech Memo 4: Existing Transportation System* and a system-level analysis of the bicycle facilities located along arterial and collector streets. As described below, the most common overall need is to provide a safe and interconnected bicycle system that encourages people to ride their bicycles, especially for trips less than three miles in length.

Bicycle Level of Traffic Stress Analysis

The bicycle facilities located along the city's arterial and collector streets were evaluated in an effort to identify potential issues that could be addressed as part of the TSP update. The APM provides a methodology for evaluating bicycle facilities within urban and rural environments called Bicycle Level of Traffic Stress (BLTS). As applied by ODOT, this methodology classifies four levels of traffic stress that a bicyclist can experience on the roadway, ranging from BLTS 1 (little traffic stress) to BLTS 4 (high traffic stress). A road segment that is rated BLTS 1 generally has low traffic volumes and travel speeds and is suitable for all cyclists, including children. A road segment that is rated BLTS 4 generally has high traffic volumes and travel speeds and is perceived as unsafe by most adults. Per the APM, BLTS 2 is considered a reasonable target for bicycle facilities due to its acceptability with the majority of people.

The BLTS score is determined based on the speed of the roadway, the number of travel lanes per direction, the presence and width of an on-street bike lane and/or adjacent parking lane, and several other factors such as the presence of a centerline. Figure 8 illustrates the results of the BLTS analysis for Molalla's arterial and collector streets. It is important to note that while some segments are shown as BLTS 3 or 4, they may have shorter segments with lower BLTS scores. Table 7 summarizes the detailed results of the BLTS analysis. As shown, there six segments rated BLTS 3 and fifteen segments rated BLTS 4.

A majority of the segments rated BLTS 3 have striped bike lanes, however they are too narrow for roadway conditions. In order for these segments to be rated BLTS 2, the striped bike lanes would need to be widened to a minimum of 6 feet and the posted speed limit would need to be reduced to 25 mph. Other segments rated BLTS 3 were evaluated as shared roadways. In order for these segments to be rated BLTS 2, the speed would need to be reduced to 25 mph or the centerline would need to be removed.



Bicycle Level of Traffic Stress
Molalla, Oregon

Figure
8

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

Table 7: BLTS Analysis Results

Street	From	To	Side	Facility Type	LTS Criteria					Bicycle LTS
					Speed (MPH)	Lanes per Direction	Bike Lane Width (feet)	Parking	Frequent Blockage	
Arterials										
OR 213	S Vick Road	Meadow Drive	Both	Mixed Traffic	45	1	N/A	No	No	4
	Meadow Drive	Toliver Road	Both	Mixed Traffic	45	1	N/A	No	No	4
	Toliver Road	31291 OR 213	Both	Mixed Traffic	45	1	N/A	No	No	4
	31291 OR 213	OR 211	Both	Bike Lanes	40	1	5.5 - 7	No	No	3
	OR 211	31670 OR 213	Both	Bike Lanes	40	1	5.5 – 7	No	No	3
	31670 OR 213	City Limits (south)	Both	Mixed Traffic	40	1	N/A	No	No	4
OR 211	City Limits (west)	OR 213	Both	Bike Lanes	45	1	5.5 – 7	No	No	4
	OR 213	Commercial Parkway	Both	Bike Lanes	40	1	5.5 – 7	No	No	3
	Commercial Parkway	S Ona Way	Both	Mixed Traffic	40	1	N/A	No	No	4
	S Ona Way	Leroy Avenue	Both	Mixed Traffic	40	1	N/A	No	No	4
	Leroy Avenue	Ridings Avenue	Both	Mixed Traffic	40	1	N/A	No	No	4
	Ridings Avenue	Dixon Avenue	Both	Bike Lanes	40	1	<5.5	No	No	4
	Dixon Avenue	Molalla Avenue	Both	Mixed Traffic	25	1	N/A	Yes	No	2
	Molalla Avenue	Grange Avenue	Both	Mixed Traffic	25	1	N/A	Yes	No	2
	Grange Avenue	S Mathias Road	Both	Mixed Traffic	35	1	N/A	Yes	No	4
	S Mathias Road	Shirley Street	Both	Mixed Traffic	35	1	N/A	Yes	No	4
	Shirley Street	City Limits (east)	Both	Mixed Traffic	45	1	N/A	No	No	4
Molalla Avenue	City Limits (north)	Glory Lane	Both	Mixed Traffic	35	1	N/A	No	No	4
	Glory Lane	Heintz Street	Both	Mixed Traffic	25	1	N/A	No	No	2
	Heintz Street	City Limits (south)	Both	Mixed Traffic	25	1	N/A	Yes	No	2
Major Collectors										
S Vick Road	OR 213	Molalla Avenue	Both	Mixed Traffic	40[2]	1	N/A	No	No	4
Toliver Road	City Limits (west)	OR 213	Both	Mixed Traffic	45	1	N/A	No	No	4
Toliver Road	OR 213	Storey Drive	Both	Mixed Traffic	35	1	N/A	No	No	3
Toliver Road	Storey Drive	Molalla Avenue	Both	Bike Lanes	25	1	5.5 – 7	No	No	1
Leroy Avenue	Toliver Road	OR 211	Both	Mixed Traffic	25	1	N/A	Yes	No	2

Shirley Street[1]	Molalla Avenue	OR 211	Both	Mixed Traffic	30	1	N/A	Yes	No	2
E 5th Street	Molalla Avenue	May Street	Both	Bike Lanes	25	1	5.5 – 7	Yes	No	1
	May Street	Eckerd Avenue	South	Mixed Traffic	25	1	N/A	Yes	No	2
	May Street	Eckerd Avenue	North	Bike Lane	25	1	5.5 – 7	No	No	1
	Eckerd Avenue	Cole Street	Both	Bike Lanes	25	1	5.5 – 7	Yes	No	1
	Cole Street	Stower Road	South	Mixed Traffic	25	1	N/A	Yes	No	2
	Cole Street	Stower Road	North	Bike Lane	25	1	5.5 – 7	No	No	1
	May Street	S Mathias Road	Both	Bike Lanes	25	1	5.5 – 7	No	No	1
S Mathias Road	OR 211	City Limits (south)	Both	Mixed Traffic	30	1	N/A	No	No	3
Vaughan Road	Molalla Avenue	OR 211	Both	Mixed Traffic	55[2]	1	N/A	No	No	3
Minor Collector										
Ridings Avenue[1]	Toliver Road	OR 211	Both	Mixed Traffic	25	N/A[1]	N/A	No	No	1
Frances Street[1]	Molalla Avenue	N Cole Avenue	Both	Mixed Traffic	25	N/A[1]	N/A	Yes	No	1
N Cole Avenue[1]	City Limits (north)	OR 211	Both	Mixed Traffic	25	N/A[1]	N/A	Yes	No	1

[1] Unmarked Centerline
[2] Basic Rule Speed
Shaded cells segments that do not meet the LTS 2 target.

A majority of the segments rated BLTS 4 are located along OR 213 and OR 211 where posted speeds range from 25 to 45 mph and bike lanes are not present. The segment of N Molalla Avenue north of Glory Lane is also rated BLTS 4 due to the posted speeds exceeding 25 mph and the lack of bike lanes. In order for these segments to be rated BLTS 2, bike lanes with a minimum width of 6 feet would need to be installed and the speed limit would need to be reduced to 30 mph. Enhanced facilities, such as shared-use paths or buffered bike lanes may also be needed in some areas where traffic volumes and/or travel speeds cannot be reduced. It should also be noted that a majority of the shared-roadway segments that were rated BLTS 2 could include signage and potentially striping to remind motorist to share the road. The signing and striping can also provide important wayfinding for bicyclists to inform them of the preferred bicycle route.

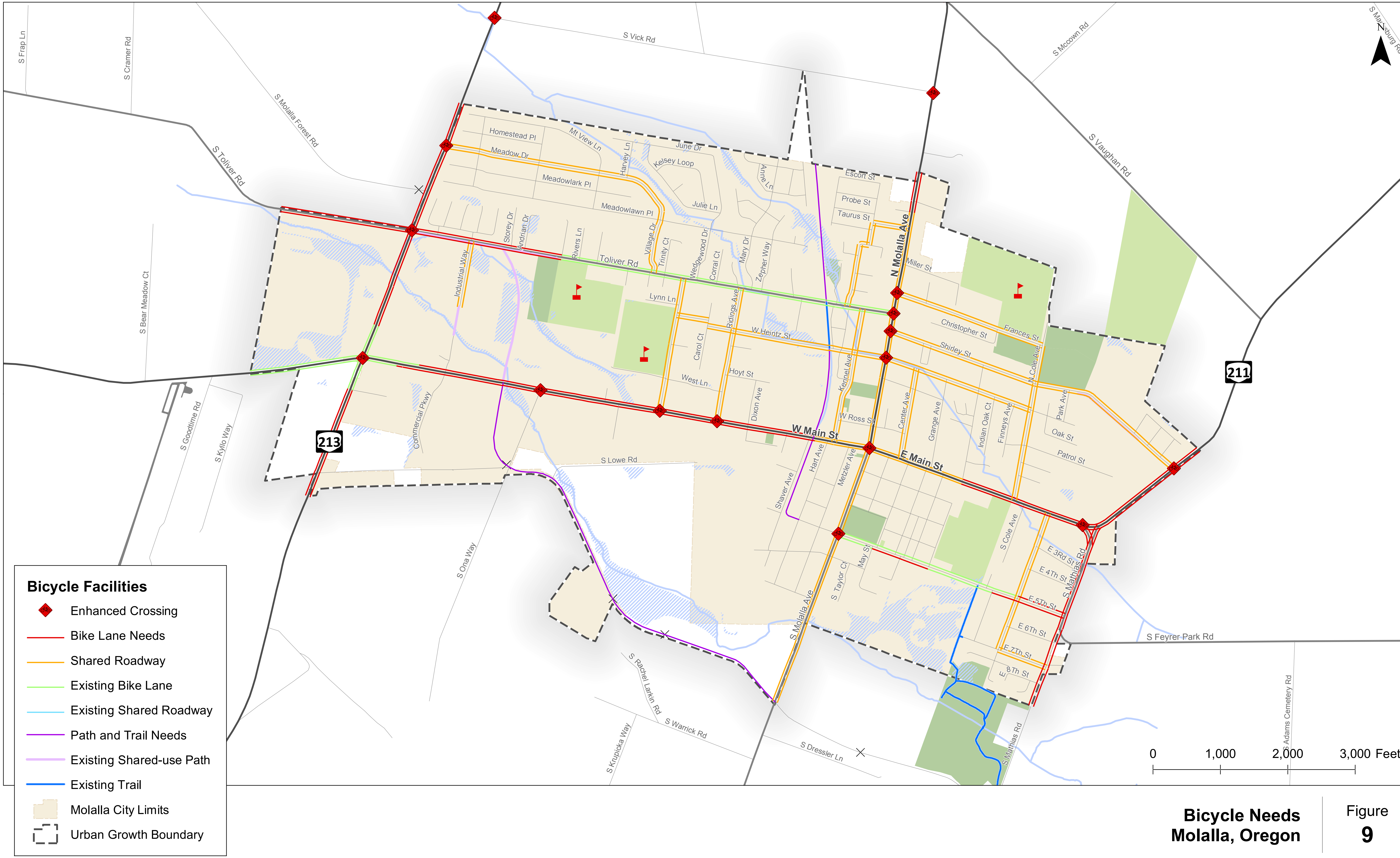
System Connectivity

A well-connected bicycle system provides continuous bike lanes and other bicycle facilities between essential destinations, such as residential neighborhoods, schools, parks, and retail/commercial centers. Strategies to improve bicycle connectivity include identifying, prioritizing, and ultimately constructing new on-street bike lanes, shared-use pavement markings, bicycle crossings, shared-use paths, and bicycle parking.

On-street Bike Lanes

As indicated in *Tech Memo 4: Existing Transportation System* and in the BLTS analysis described above, there are several arterial and collector streets that need new on-street bike lanes and other bicycle facilities to improve connectivity. Figure 9 illustrates the bicycle system needs within Molalla. The following summarizes the arterials and collector streets where there is a need for new on-street bike lanes on one or two sides of the roadway:

- 5h Avenue from S Molalla Avenue to Mathias Road
- OR 213 from OR 211 to north city limits
- OR 213 from OR 211 to south city limits
- OR 211 from OR 213 to Shaver Avenue
- OR 211 from Fenton Avenue to east city limits
- N Molalla Avenue from Heintz Street to north city limits
- S Molalla Avenue from 5th Street to south city limits
- Toliver Road from west city limits to OR 213
- Toliver Road from OR 213 to Zimmerman Lane
- Mathias Road from OR 211 to south city limits



Bicycle Needs
Molalla, Oregon

Figure
9

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

Shared-Use Streets

Arterials and collectors cannot fully address bicycle travel needs in and around the city. Bicycle trips can and should be accommodated on lower classified streets with lower traffic volumes and travel speeds that offer parallel or alternative routes to essential destinations, such as schools, parks, and retail/commercial centers. These facilities could be designated as shared-use streets or could have a specific designation such as a "bike boulevard" where treatments are applied to the roadway to enhance the bicycle environment and/or make additional connections to bicycle destinations. There are several streets where shared roadway pavement markings could be used to improve access and circulation for cyclists. The streets include:

- 7th Avenue from Stowers Road to Mathias Road
- Center Avenue from OR 211 to Heintz Street
- N Cole Avenue from Frances Street to OR 211
- Francis Street from Molalla Avenue to N Cole Avenue
- Heintz Street from Leroy Avenue to N Cole Avenue
- Industrial Way from OR 211 to southern terminus
- Kennel Avenue from OR 211 to Toliver Road
- Leroy Avenue from OR 211 to Toliver Road
- Meadow Drive-Village Drive from OR 213 to Toliver Road
- S Molalla Avenue from OR 211 to 5th Street
- N Molalla Avenue from OR 211 to Heintz Street
- OR 211 from Shaver Avenue to Fenton Avenue
- Ridings Avenue from Toliver Road to OR 211
- Shirley Street from N Molalla Avenue to OR 211
- Stowers Road from OR 211 to 7th Avenue
- Toliver Drive from Toliver Road to N Molalla Avenue

Bicycle Crossings

Intersections are typically the most dangerous locations within a bicycle network, as there are a high number of conflict points with right and left-turning vehicles and cross street traffic. There are various configurations for addressing bicycle needs alongside right-turn lanes, although the desired configuration is to have the right-turn lane to the right of the bicycle lane, with right-turning vehicles yielding to through cyclists as they cross the bicycle lane. The following summarizes the bicycle crossing needs within Molalla with a focus on existing intersections that do not provide bicycle crossings.

- Enhanced bicycle crossing at OR 213 and Vick Road
- Enhanced bicycle crossing at OR 213 and Meadow Drive

- Enhanced bicycle crossing at OR 213 and Toliver Road
- Enhanced bicycle crossing at OR 213 and OR 211
- Enhanced bicycle crossing at OR 211 and Ona Way
- Enhanced bicycle crossing at OR 211 and Leroy Avenue
- Enhanced bicycle crossing at OR 211 and Ridings Avenue
- Enhanced bicycle crossing at OR 211 and Molalla Avenue
- Enhanced bicycle crossing at OR 211 and Mathias Road
- Enhanced bicycle crossing at OR 211 and Shirley Street
- Enhanced bicycle crossing at N Molalla Avenue and Vick Road
- Enhanced bicycle crossing at N Molalla Avenue and Francis Street
- Enhanced bicycle crossing at N Molalla Avenue and Toliver Road
- Enhanced bicycle crossing at N Molalla Avenue and Shirley Street
- Enhanced bicycle crossing at N Molalla Avenue and Heintz Street
- Enhanced bicycle crossing at S Molalla Avenue and 5th Street

Figure 9 also illustrates the locations of the crossing needs. An enhanced bicycle crossing at each of these locations would improve connectivity along the roadways as well as access to essential destinations.

Bicycle Parking

The availability of bicycle parking is an important component of a well-designed bicycle system. Lack of proper storage facilities discourages potential riders from traveling by bicycle. Bicycle racks should be located at significant activity generators including schools, parks, and retail/commercial areas. Bicycle racks should be placed in highly-visible locations and within convenient proximity to main building entrances. Bicycle racks should be designed to provide two points of contact to the bicycle (e.g., so the user can lock both the wheel and the frame to the rack). Bicycle lockers or other storage facilities would be helpful at locations where long-term parking is expected, such as major employment centers. The attractiveness of bicycle parking may also be improved by providing covered parking and/or secured facilities where bicycles may be locked away.

The city's bicycle parking standards are found in Chapter 17-3.5.040 of the Molalla Municipal Code. Table 17-3.5.040.A lists the minimum number of required bicycle parking spaces by land use. Bicycle parking is required for new multi-family residential, commercial, industrial, community service, parks, schools, institutional uses and places of worship, and other uses. See Table 3 in Tech Memo 1 for preliminary recommendations regarding potential changes to bicycle parking standards.

MOTOR VEHICLE SYSTEM NEEDS

A well-connected transportation network minimizes the need for out-of-direction travel while supporting an efficient distribution of travel demand among multiple parallel roadways. The most common example of an efficient transportation network is the traditional grid system, with north-south and east-west streets spaced at generally equal distance. OR 213, OR 211, Molalla Avenue, Toliver Road, and Mathias Road are all part of a larger grid system that provides connectivity on a regional level as well as connectivity within Molalla. At a high level, Molalla's street network is generally well spaced, forming a grid system for its arterials and collector streets. A detailed look at Molalla's neighborhood and local streets shows that many neighborhoods in Molalla are made up of less connected networks of cul-de-sacs and stub streets that conform to the industrial land uses or natural landscape features. The following sections highlight the needs associated with street system connectivity within Molalla.

Arterial Streets

Per the city's current TSP, arterials are primarily intended to serve traffic entering and leaving the urban area. While arterials may provide access to adjacent land uses, that function is subordinate to the travel service provided to major traffic movements. Arterials are the longest-distance, highest-volume roadways within the UGB. Although the streets focus on serving longer distance trips, pedestrian and/or bicycle activities often are also associated with the arterial streetscape.

Based on a review of the existing arterial system within Molalla as well as the unincorporated areas that surround Molalla, there may be a need for a new arterial that connects N Molalla Avenue to OR 211 north of the UGB and a new arterial that connects OR 213 to Molalla Avenue and Mathias Road south the UGB.

- Clackamas County owns and operates the roadways north of the UGB. Vick Road provides an east-west connection between OR 213 and Molalla Avenue; Vaugh Road provides an east-west connection between Molalla Avenue and OR 211. Clackamas County classifies Vick Road (and N Molalla Avenue) as a minor arterial (or major collector per Molalla standards) and Vaughn Road as a local street. If/when these streets are incorporated into the Molalla UGB, the City should consider maintaining the classification of Vick Road (and N Molalla Avenue) and reclassifying Vaugh Road as an arterial. They could also consider extending Vick Road, east to Vaughn Road.
- Clackamas County also owns and operates the roadways south of the UGB. There are currently no roadways that provide a continuous connection between OR 213 and Molalla Avenue. Warrick Road may provide an opportunity to create an east-west connection in the future. If/when these streets are incorporated into the Molalla UGB, the City should consider creating a continuous connection between OR 213 and Molalla Avenue and reclassifying the streets as an arterial.

Collector Streets

Per the city's current TSP, collector streets facilitate the movement of city traffic within the UGB. Collectors provide some degree of access to adjacent properties, while maintaining circulation and mobility for all users. Major collectors are distinguished by their connectivity and higher traffic volumes, although they are designed to carry lower traffic volumes at slower speeds than arterials. Major collectors are characterized by two or three-lane facilities. Minor collectors carry lower volumes than major collectors and have two-lane cross-sections.

Based on a review of the existing collector street system, there may be a need for several new collector streets within the City, including a new collector south of OR 211 that connects Mathias Road to Molalla Avenue and OR 211, a new collector between Molalla Avenue and OR 213, and a new collector east of Molalla Avenue. Additional information on these potential needs is provided below.

- New east-west collector – 5th Street and Leroy Avenue are designated as collector streets in the city's current TSP. Connecting these streets by creating a new roadway segment south of OR 211 would allow for increased connectivity within the City while providing a new continuous connection from Mathias Road to Molalla Avenue. The area between 5th Street and Leroy Avenue is largely occupied by low density land use including a wood mill and self-storage units.
- New north-south collector – OR 213 and Molalla Avenue are located approximately 1.4 miles apart; therefore, a new collector could be identified between the two streets to improve connectivity within the city. The city's current TSP identifies an extension of Ridings Avenue as a potential connection; however, existing development patterns preclude the future connection. Per discussions with City staff, Marry Drive should be amended to reflect a major collector designation in the TSP Update.
- New north-south collector – Molalla Avenue and OR 211 are located approximately 1.0 miles apart; therefore, a new collector could be identified between the two streets to improve collector connectivity within the City. The city's current TSP identifies an extension of N Cole Avenue as a potential connection; this connection is still feasible today.
- Molalla Forest Road is identified as an arterial in the city's current TSP. This designation was primarily based on the notion that Molalla Forest Road would become a freight route allowing trucks to bypass the downtown area. Based on the existing functionality of Molalla Forest Road as well as conversations with City staff, Molalla Forest Road should be amended to reflect a major collector designation in the TSP Update and OR 211 should be amended to reflect an arterial designation in the TSP Update.

Neighborhood Streets

Per the city's current TSP, the primary function of neighborhood streets is to connect neighborhoods with the collector and arterial street system, facilitate the movement of local traffic, and provide access to abutting land uses. Speeds on these facilities should remain low to ensure community livability and safety for pedestrians and bicyclists of all ages. On-street parking is more prevalent and pedestrian amenities are typically provided. Striped bike lanes are unnecessary for most neighborhood streets because the traffic volumes and speeds should allow cyclists to travel concurrently with motorists. Based on a review of the existing neighborhood street network, there may be a need for two new neighborhood streets between OR 213 and Leroy Avenue as well as several extensions of existing neighborhood streets. Additional information on these potential needs is provided below.

- New north-south neighborhood street – OR 213 and Leroy Avenue are approximately 0.75 miles apart; therefore, two new neighborhood streets could be identified to improve connectivity. This may involve changing the designation of existing roadways and/or constructing new roadways to better meet the needs.
- Meadow Drive is identified as a major collector between OR 213 and Meadowlawn Place in the city's current TSP. Based on the existing functionality of Meadow Drive as well as conversations with City staff, Meadow Drive should be amended to reflect a neighborhood street designation in the TSP Update.
- Several neighborhood street extensions are also identified in the current TSP that are still viable today. The extensions include:
    - Cascade Lane to the north of the UGB
    - Harvey Lane to the north of the UGB
    - Church Street to the east of the UGB
    - Affolter Avenue to Francis Street and to the north of the UGB
    - Commercial Parkway south to the private road

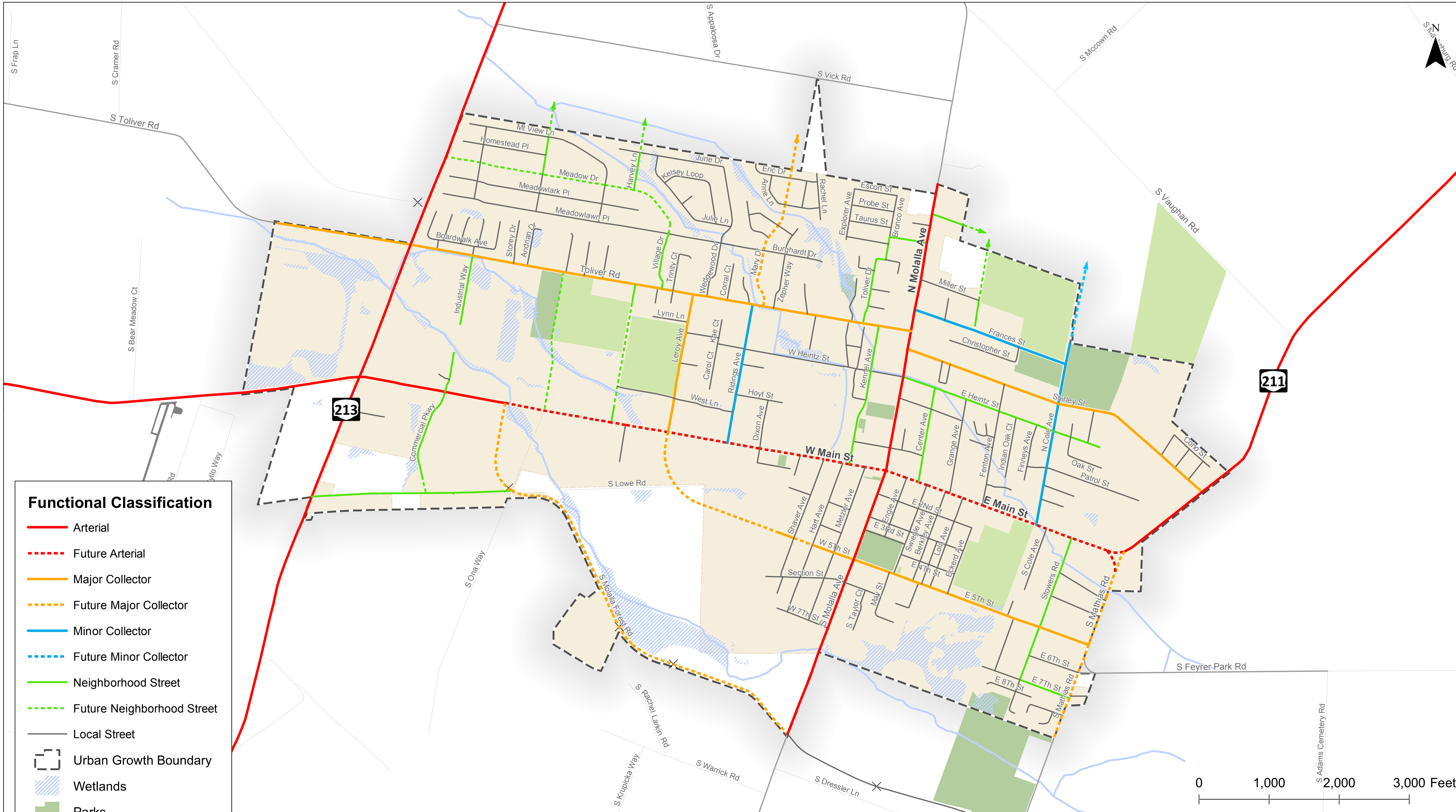
Per discussions with City staff, the neighborhood street designation may be combined with the minor collector street designation and the streets currently designated as neighborhood streets may be redesignated as minor collectors or local streets as appropriate. Figure 10 illustrates the arterial, collector, and neighborhood street connectivity needs.

Local Street

Per the city's current TSP, local streets are primarily intended to provide access to abutting land uses. Local street facilities offer the lowest level of mobility and consequently tend to be short, low-speed facilities. As such, local streets should primarily serve passenger cars, pedestrians, and bicyclists; heavy truck traffic should be discouraged. On-street parking is common and sidewalks are typically present. Figure 11 illustrates the local street connectivity needs within Molalla. The arrows shown in Figure 11 represent the placement and general direction of potential connections. The following summarizes the opportunities identified in Figure 11 to show the potential impact of the connection on local street connectivity.

- Faurie Street from roadway terminus to Miller Street
- Eric Drive from roadway terminus to north
- Rachel Lane from roadway terminus to north

As new development occurs, the opportunities identified in Figure 11 should be implemented to create a more efficient local street network. It should be noted that the Faurie Street extension is located within public right-of-way and therefore, will likely not be a challenge to develop as part of future development or redevelopment.



Arterial, Collector and Neighborhood Route Connectivity Needs
Molalla, Oregon

Figure
10

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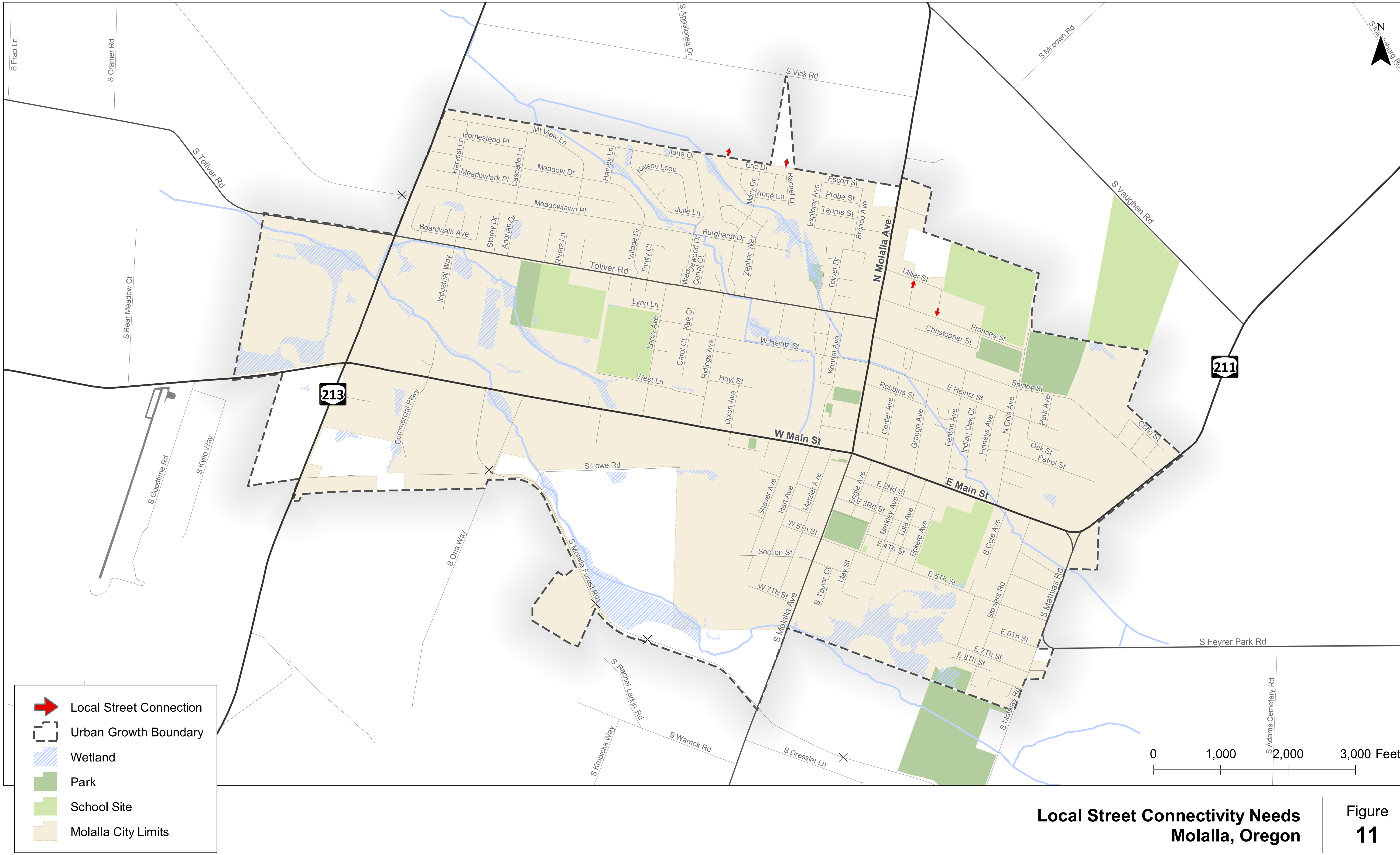
KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla



Local Street Connectivity Needs
Molalla, Oregon

Figure
11

Future Traffic Operations

Future traffic operations were evaluated at the sixteen study intersections in accordance with the assumptions and methodologies identified in *Tech Memo 2A: TSP Analyses and Methodology.*

Forecast Traffic Volumes

Forecast traffic volumes were developed for the study intersections based on the Cumulative Analysis methodology described in the ODOT APM. This type of analysis combines growth in regional traffic volumes with growth in local traffic volumes associated with projected household and employment growth within the city. A summary of the traffic volume projection process is provided below.

Cumulative Analysis

The cumulative analysis process accounts for the following four categories of vehicle trips.

- External-External (through trips): vehicles with an origin and destination outside the city limits. An example of an external-external trip is someone traveling from Oregon City to Silverton along OR 213 or from Woodburn to Estacada along OR 211.
- External-Internal (inbound trips): vehicles with an origin outside the city limits and a destination inside the city limits. An example of an external-internal trip is someone who works in Portland or Salem but returns home to Molalla during the evening peak hour.
- Internal-External (outbound trips): vehicles with an origin inside the city limits and a destination outside the city limits. An example of an internal-external trip is someone who works in Molalla but returns home to Silverton during the evening peak hour.
- Internal-Internal (local trips): vehicles with an origin and destination inside the city limits. An example of an internal-internal trip is someone who travels from their home to the grocery store without leaving the city.

There are several steps required to prepare a cumulative analysis, including:

- Developing a growth rate projection for highway traffic volumes;
- Identifying where household and employment growth is likely to occur in the community;
- Developing estimates of the number of vehicle trips associated with household and employment growth, and;
- Allocating those trips across the city to various growth areas.

An overview of each of these steps is presented below.

Regional Traffic Growth

ODOT's Future Volume Tables were used to develop regional growth rates for OR 213 and OR 211. Based on the tables, traffic volumes along OR 213 are projected to increase by approximately 46 percent north of the city limits and by 50 percent south of the city limits. Similarly, traffic volumes along OR 211 are projected to increase by approximately 50 percent west of the city limits and 37 percent east of the city limits. These growth rates were applied to existing traffic volumes along OR 213 and OR 211 to represent growth in regional traffic volumes.

Household and Employment Growth

Projected household and employment growth also contributes to future growth in traffic volumes. Growth estimates were developed based on the PRC's Coordinated Population Forecast for Clackamas County, the draft Economic Opportunities (ECO) Analysis prepared by Johnson Economics, and the Buildable Land Inventory (BLI) prepared by Winterbrook Planning, as well as a review of existing land use, zoning designations, and development patterns. Additional information on projected household and employment growth is provided earlier in this memo and in Attachment "B".

Trip Generation

The projected household and employment growth can be equated to increases in local traffic volumes by calculating the trip generation of the future uses. Trip generation estimates were prepared for the TSP update based on information provided in the standard reference manual, *Trip Generation*, *9th Edition*, published by the Institute of Transportation Engineers (ITE). Tables D-1 and D-2 in Attachment "D" summarize the total trips by TAZ for scenario 1 and 2 respectively. As indicated earlier in this memo, Scenario 1 reflects the level of development that can be accommodated within the City based on the current zoning designations and development patters; the second scenario reflects all the development associated with the population and employment growth; both scenarios reflect conditions within the current UGB.

Traffic Analysis Zones

The trips associated with the projected household and employment growth were distributed throughout the city based on the type of trips (i.e. external-external, external-internal, internal-external, internal-internal) and the location of the TAZs developed for the project. Additional information on the TAZs is provided earlier in this memo and in Attachment "B".

Peak Hour Traffic Operations (Scenario 1)

Figure 12 illustrates the location of the study intersections. Figure 13 and Table 8 summarize the peak hour traffic operations at the study intersections under year 2040 traffic conditions (Scenario 1). *Attachment "E" contains the year 2040 traffic conditions (Scenario 1) worksheets.*

Table 8: Peak Hour Traffic Operations – Year 2040 Traffic Conditions (Scenario 1)

Map ID	Intersection	Existing Level of Service (LOS)	Future Level of Service (LOS)	Delay (Sec)	Volume/ Capacity (V/C)	Measure of Effectiveness (MOE)		MOE Met?
						Agency	Maximum	
1	OR 213/Vick Road	D	F	>50.0	0.30	ODOT	v/c 0.80	Yes
2	OR 213/Meadow Drive	C	F	>50.0	0.77	ODOT	v/c 0.90	Yes
3	OR 213/Toliver Road	F	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
4	OR 213/OR 211	C	F	>80.0	>1.0	ODOT	v/c 0.90	***No***
5	OR 211/Ona Way	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
6	OR 211/Leroy Avenue	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
7	OR 211/Ridings Avenue	C	F	>50.0	0.90	ODOT	v/c 0.90	Yes
8	OR 211/S Molalla Avenue	E	F	>80.0	>1.0	ODOT	v/c 1.0[1]	***No***
9	OR 211/Mathias Road[2]	C	F	>50.0	0.68	ODOT	v/c 0.95	Yes
10	OR 211/Shirley Street	B	C	17.9	0.19	ODOT	v/c 0.90	Yes
11	N Molalla Avenue/Vick Road	B	B	12.0	0.14	City	LOS E	Yes
12	N Molalla Avenue/Toliver Road	B	C	23.0	0.58	City	LOS E	Yes
13	N Molalla Avenue/Shirley Street	B	C	19.5	0.36	City	LOS E	Yes
14	N Molalla Avenue/Heintz Street	B	C	20.5	0.21	City	LOS E	Yes
15	S Molalla Avenue/5th Street	B	C	24.7	0.40	City	LOS E	Yes
16	5th Street/Mathias Road	B	B	11.1	0.10	City	LOS E	Yes

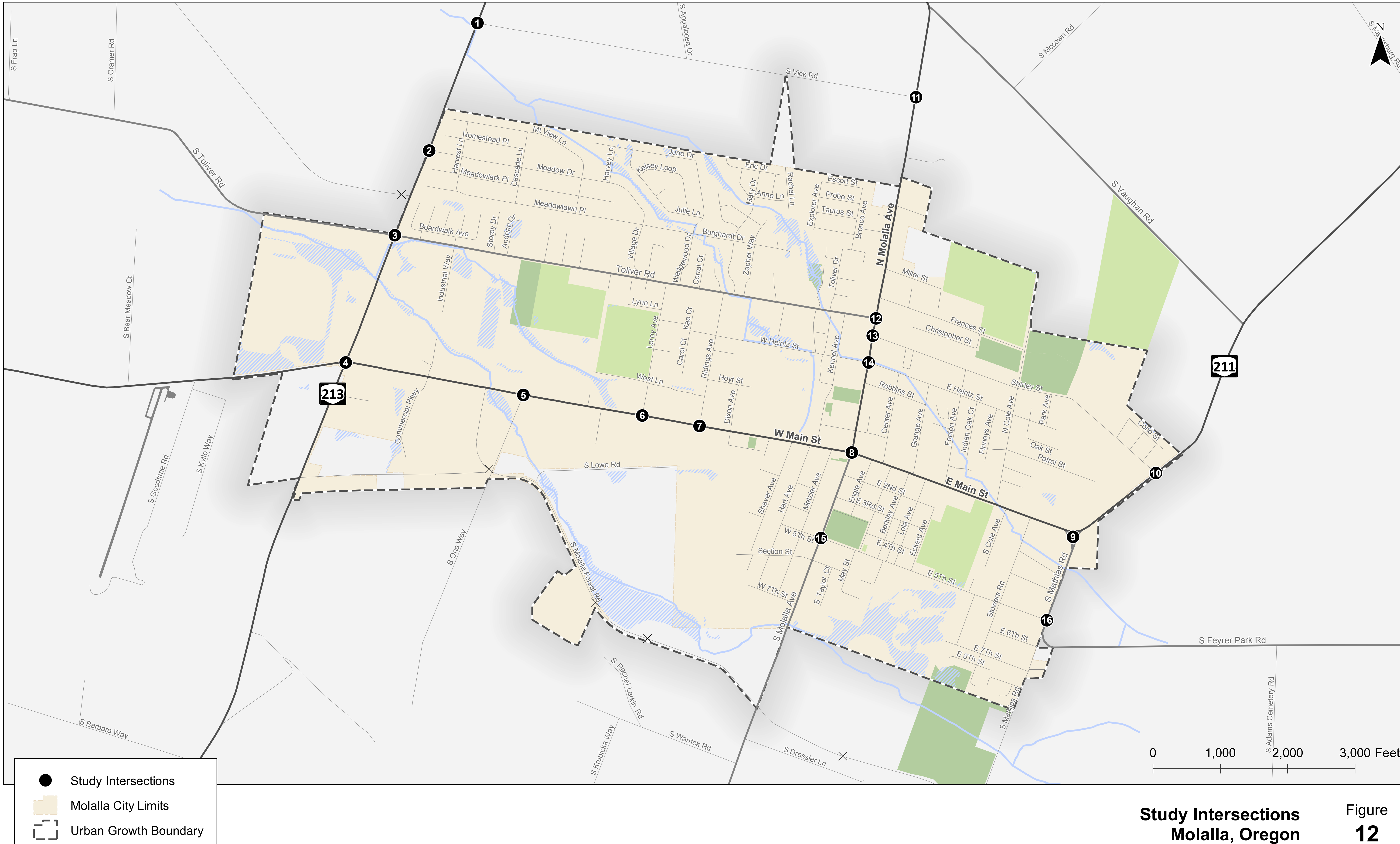
Notes:
LOS = Intersection Level of Service (Signal), Critical Movement Level of Service (TWSC).
Delay = Intersection Average vehicle delay (Signal), critical movement vehicle delay (TWSC).
V/C = Intersection V/C (Signal) critical movement V/C (TWSC).
MOE = Measure of Effectiveness

1. The OR 211/Molalla Avenue intersection is located within a Special Transportation Area (STA). STAs allow for higher levels of congestion and therefore, have higher mobility targets.
2. The OR 211/Mathias Road intersection was evaluated as three separate intersections due to its unique configuration and functionality. The most critical movement of the three intersections was used to represent the intersection operations.

As shown in Table 8, five study intersections are forecasted to exceed their acceptable mobility standards and targets under year 2040 traffic conditions Scenario 1. Additional information about the operations issues identified at these study intersections is provided below.

OR 213/Toliver Road

The westbound approach to the OR 213/Toliver Road intersection is projected to operate at level of service (LOS) F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area between OR 213 and Molalla Avenue, north and south of Toliver Road. Preliminary signal warrants indicate that a traffic signal is warranted under year 2040 traffic conditions. *Attachment "F" contains the traffic signal warrant worksheets.*

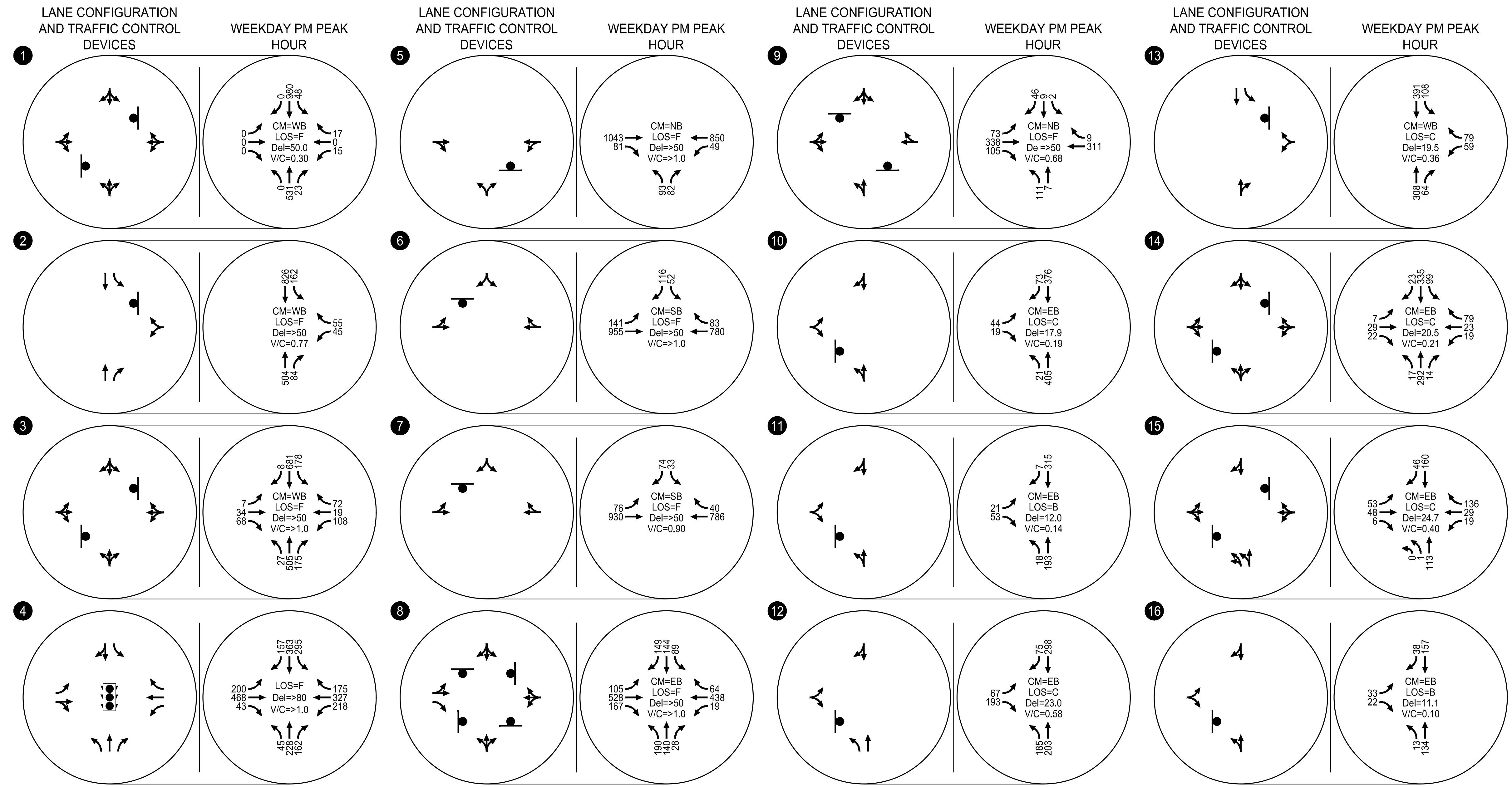


Study Intersections
Molalla, Oregon

Figure
12

KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla



CM = CRITICAL MOVEMENT (TWSC)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED/AWSC) / CRITICAL MOVEMENT LEVEL OF SERVICE (TWSC)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED/AWSC) / CRITICAL MOVEMENT CONTROL DELAY (TWSC)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2040 Traffic Operations (Scenario 1)
Weekday PM Peak Hour
Molalla, Oregon

Figure 13

OR 213/OR 211

The eastbound, westbound, and southbound left-turn movements at the OR 213/OR 211 intersection are projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of regional traffic growth as well as local traffic growth within the area adjacent to the intersection.

OR 211/Ona Way

The northbound left-turn movement at the OR 211/Ona Way intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between OR 213 and Molalla Avenue, south of OR 211 as well as the general lack of connectivity within the area. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "F" contains the traffic signal warrant worksheets.*

OR 211/Leroy Avenue

The southbound left-turn movement at the OR 211/Leroy Avenue intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between the former Molalla Forest Road and Leroy Avenue, north of OR 211. Hezzie Lane may offer alternative access to this area in the future. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "F" contains the traffic signal warrant worksheets.*

OR 211/S Molalla Avenue

The northbound, southbound, eastbound, and westbound approaches to the OR 211/S Molalla Avenue intersection are projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected in the area adjacent to the intersection. Preliminary signal warrants indicate that a traffic signal is warranted under year 2040 traffic conditions. *Attachment "F" contains the traffic signal warrant worksheets.*

Queueing

A queuing analysis was conducted at the signalized study intersections. Table 9 summarizes the 95th percentile queues during the weekday p.m. peak hours under year 2040 traffic conditions. The vehicle queues and storage lengths are rounded to the nearest 25-feet. The storage lengths reflect the striped storage for each movement at the intersections.

Table 9: Queuing – Year 2040 Traffic Conditions (Scenario 1)

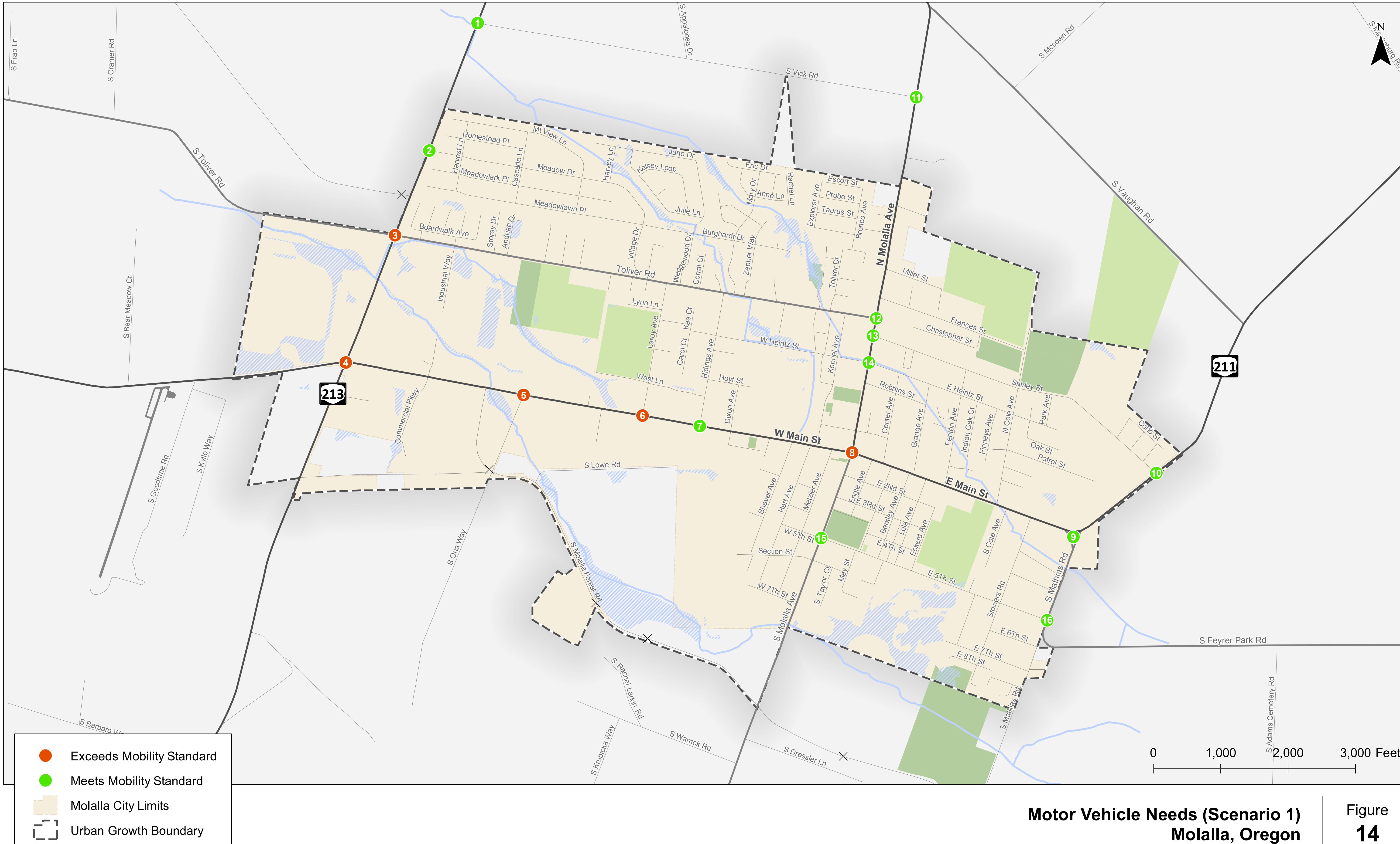
Intersection	Movement	95th Percentile Queue	Storage Length (feet)	Adequate?
OR 213/OR 211	Eastbound Left	#450	275	***No***
	Westbound Left	#475	225	***No***
	Northbound Left	100	250	Yes
	Southbound Left	#675	200	***No***

#: 95th percentile volume exceeds capacity, queue may be longer.
m: Volume for 95th percentile queue is metered by upstream signal.

As shown in Table 9, 95th percentile queues at the OR 213/OR 211 intersection are projected to exceed the stripped storage for the following turning movements.

- The eastbound left-turn movement is expected to exceed the striped storage for the movement by approximately 175 feet (seven vehicles).
- The westbound left-turn movement is expected to exceed the striped storage for the movement by approximately 250 feet (10 vehicles); however, additional striped storage is available within the center two-way left-turn lane at the westbound approach.
- The southbound left-turn movement is expected to exceed the striped storage for the movement by approximately 475 feet (15 vehicles); however, additional striped storage is available within the center two-way left-turn lane at the westbound approach.

Figure 14 illustrates the motor vehicle needs associated with Scenario 1.



Motor Vehicle Needs (Scenario 1)
Molalla, Oregon

Figure **14**

Peak Hour Traffic Operations (Scenario 2)

Figure 15 and Table 10 summarize the peak hour traffic operations at the study intersections under year 2040 traffic conditions (Scenario 2). *Attachment "G" contains the year 2040 traffic conditions (Scenario 2) worksheets.*

Table 10: Peak Hour Traffic Operations – Year 2040 Traffic Conditions (Scenario 2)

Map ID	Intersection	Existing Level of Service (LOS)	Future Level of Service (LOS)	Delay (Sec)	Volume/ Capacity (V/C)	Measure of Effectiveness (MOE)		MOE Met?
						Agency	Maximum	
1	OR 213/Vick Road	D	F	>50.0	0.30	ODOT	v/c 0.80	Yes
2	OR 213/Meadow Drive	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
3	OR 213/Toliver Road	F	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
4	OR 213/OR 211	C	F	>80.0	>1.0	ODOT	v/c 0.90	***No***
5	OR 211/Ona Way	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
6	OR 211/Leroy Avenue	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
7	OR 211/Ridings Avenue	C	F	>50.0	>1.0	ODOT	v/c 0.90	***No***
8	OR 211/S Molalla Avenue	E	F	>80.0	>1.0	ODOT	v/c 1.0[1]	***No***
9	OR 211/Mathias Road[2]	C	F	>50.0	0.87	ODOT	v/c 0.95	Yes
10	OR 211/Shirley Street	B	C	18.4	0.20	ODOT	v/c 0.90	Yes
11	N Molalla Avenue/Vick Road	B	B	12.0	0.14	City	LOS E	Yes
12	N Molalla Avenue/Toliver Road	B	F	60.4	0.94	City	LOS E	***No***
13	N Molalla Avenue/Shirley Street	B	F	>50.0	>1.0	City	LOS E	***No***
14	N Molalla Avenue/Heintz Street	B	F	>50.0	>1.0	City	LOS E	***No***
15	S Molalla Avenue/5th Street	B	F	>50.0	>1.0	City	LOS E	***No***
16	5th Street/Mathias Road	B	B	12.0	0.17	City	LOS E	Yes

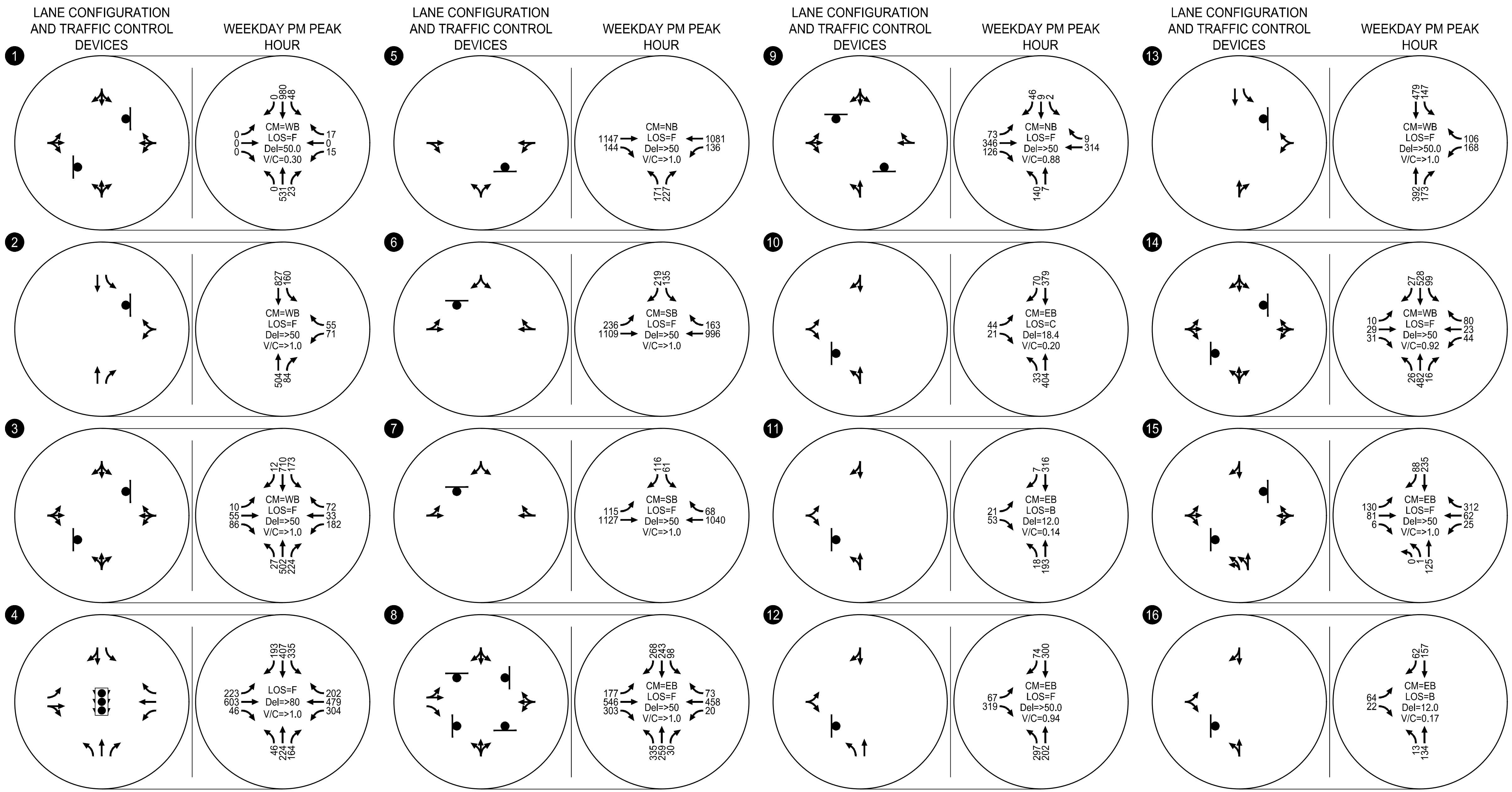
Notes:
LOS = Intersection Level of Service (Signal), Critical Movement Level of Service (TWSC).
Delay = Intersection Average vehicle delay (Signal), critical movement vehicle delay (TWSC).
V/C = Intersection V/C (Signal) critical movement V/C (TWSC).
MOE = Measure of Effectiveness

1. The OR 211/Molalla Avenue intersection is located within a Special Transportation Area (STA). STAs allow for higher levels of congestion and therefore, have higher mobility targets.
2. The OR 211/Mathias Road intersection was evaluated as three separate intersections due to its unique configuration and functionality. The most critical movement of the three intersections was used to represent the intersection operations.

As shown in Table 10, six additional study intersections are forecasted to exceed their acceptable mobility standards and targets under year 2040 traffic conditions (Scenario 2). Additional information about the operations issues identified at these study intersections is provided below.

OR 213/Meadow Drive

The westbound approach to the OR 213/Meadow Drive intersection is projected to operate at level of service (LOS) F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area between OR 213 and Molalla Avenue, north of Toliver Road. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*



CM = CRITICAL MOVEMENT (TWSC)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED/AWSC) / CRITICAL MOVEMENT LEVEL OF SERVICE (TWSC)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED/AWSC) / CRITICAL MOVEMENT CONTROL DELAY (TWSC)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Year 2040 Traffic Operations (Scenario 2)
Weekday PM Peak Hour
Molalla, Oregon

Figure 15

KITTELSON & ASSOCIATES

OR 211/Ridings Avenue

The southbound approach to the OR 211/Riding Avenue intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between Leroy Avenue and N Molalla Avenue, north of OR 211. Dixon Avenue may offer alternative access to this area in the future. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*

N Molalla Avenue/Toliver Road

The eastbound approach to the N Molalla Avenue/Toliver Road intersection is projected to operate at LOS F, but below capacity (v/c = 0.94) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between OR 213 and N Molalla Avenue, north of OR 211. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*

N Molalla Avenue/Shirley Street

The westbound approach to the N Molalla Avenue/Shirley Street intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between N Molalla Avenue and OR 211. Frances Street may offer alternative access to this area in the future. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*

N Molalla Avenue/Heintz Street

The westbound approach to the N Molalla Avenue/Heintz Street intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between N Molalla Avenue and OR 211. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*

S Molalla Avenue/5th Street

The eastbound and westbound approaches to the S Molalla Avenue/5th Street intersection is projected to operate at LOS F and above capacity (v/c > 1.0) during the weekday p.m. peak hour. This is primarily due to the relatively high level of growth expected within the area located between OR 213 and S Molalla Avenue as well as the area located between S Molalla Avenue and Mathias Road. Preliminary signal warrants indicate that a traffic signal is NOT warranted under year 2040 traffic conditions. *Attachment "H" contains the traffic signal warrant worksheets.*

Queueing

A queuing analysis was conducted at the signalized study intersections. Table 11 summarizes the 95th percentile queues during the weekday p.m. peak hours under year 2040 future conditions (Scenario 2). The storage lengths reflect the striped storage for each movement at the intersections.

Table 11: Queuing – Year 2040 Traffic Conditions (Scenario 2)

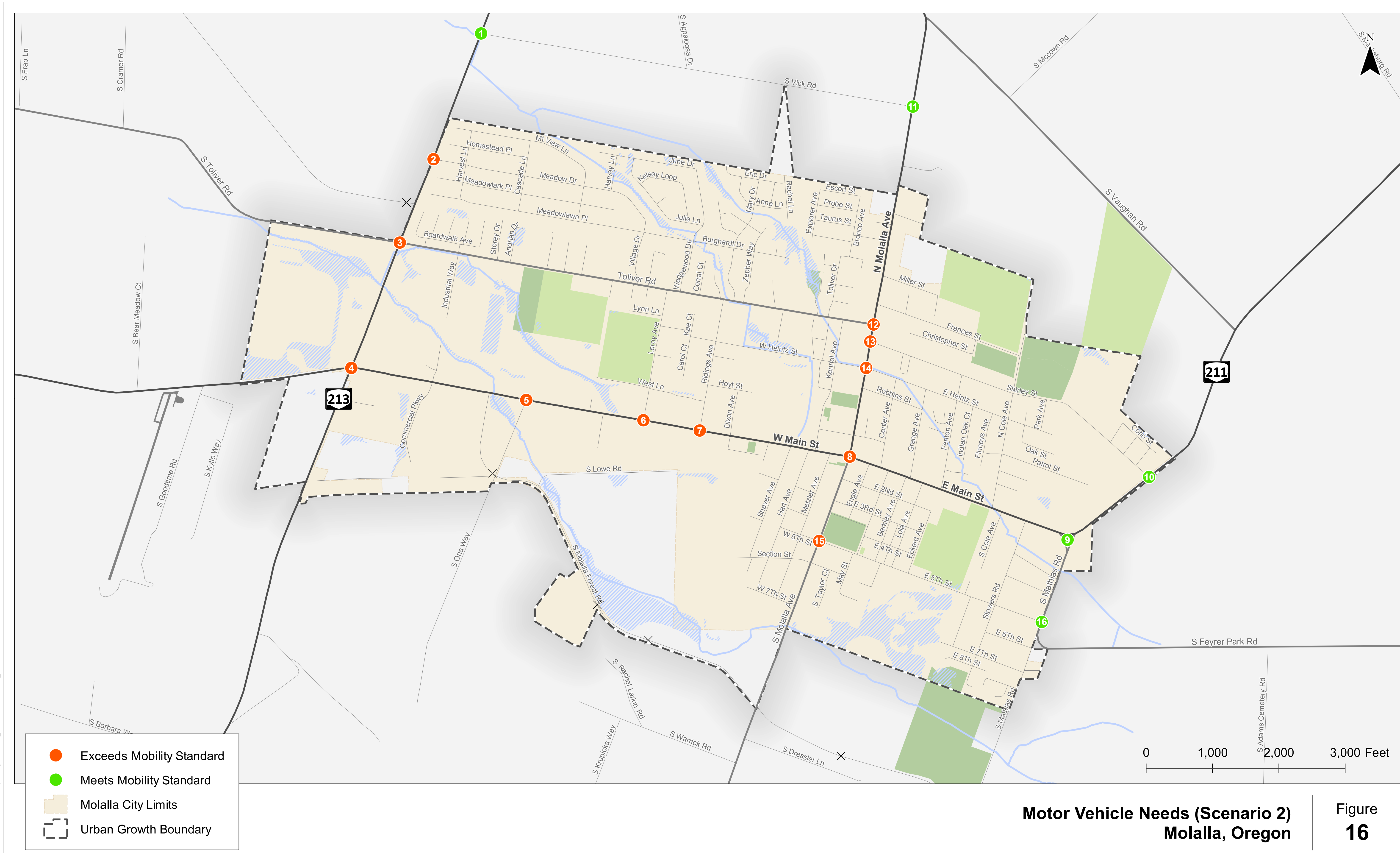
Intersection	Movement	95th Percentile Queue	Storage Length (feet)	Adequate?
OR 213/OR 211	EBL	#500	275	***No***
	WBL	#700	225	***No***
	NBL	100	250	Yes
	SBL	#775	200	***No***

Where WB = Westbound, SB = Southbound, EB = Eastbound, NB = Northbound, L = Left, R = Right
#: 95th percentile volume exceeds capacity, queue may be longer.
m: Volume for 95th percentile queue is metered by upstream signal.

As shown in Table 11, 95th percentile queues at the OR 213/OR 211 intersection are projected to exceed the stripped storage for the following turning movements.

- The eastbound left-turn movement is expected to exceed the striped storage for the movement by approximately 225 feet (nine vehicles).
- The westbound left-turn movement is expected to exceed the striped storage for the movement by approximately 475 feet (15 vehicles); however, additional striped storage is available within the center two-way left-turn lane at the westbound approach.
- The southbound left-turn movement is expected to exceed the striped storage for the movement by approximately 575 feet (23 vehicles); however, additional striped storage is available within the center two-way left-turn lane at the westbound approach.

Figure 16 illustrates the motor vehicle needs associated with Scenario 1.



Motor Vehicle Needs (Scenario 2)
Molalla, Oregon

Figure
16

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

KITTELSON & ASSOCIATES

Traffic Safety

As indicated in *Tech Memo 4: Existing Transportation System,* the observed crash rates at the OR 213/Toliver Road, OR 211/Leroy Avenue, and the OR 211/Mathias Road intersections currently exceed the 90th percentile crash rates for similar facilities. In addition, the observed crash rate at the OR 213/Toliver Road, OR 213/OR 211, and OR 211/Molalla Avenue intersections currently exceed the critical crash rate by intersection volume. Further review of the crash rates at the study intersections indicates that the increase in traffic volumes is not expected to result in any additional intersections that warrant further review.

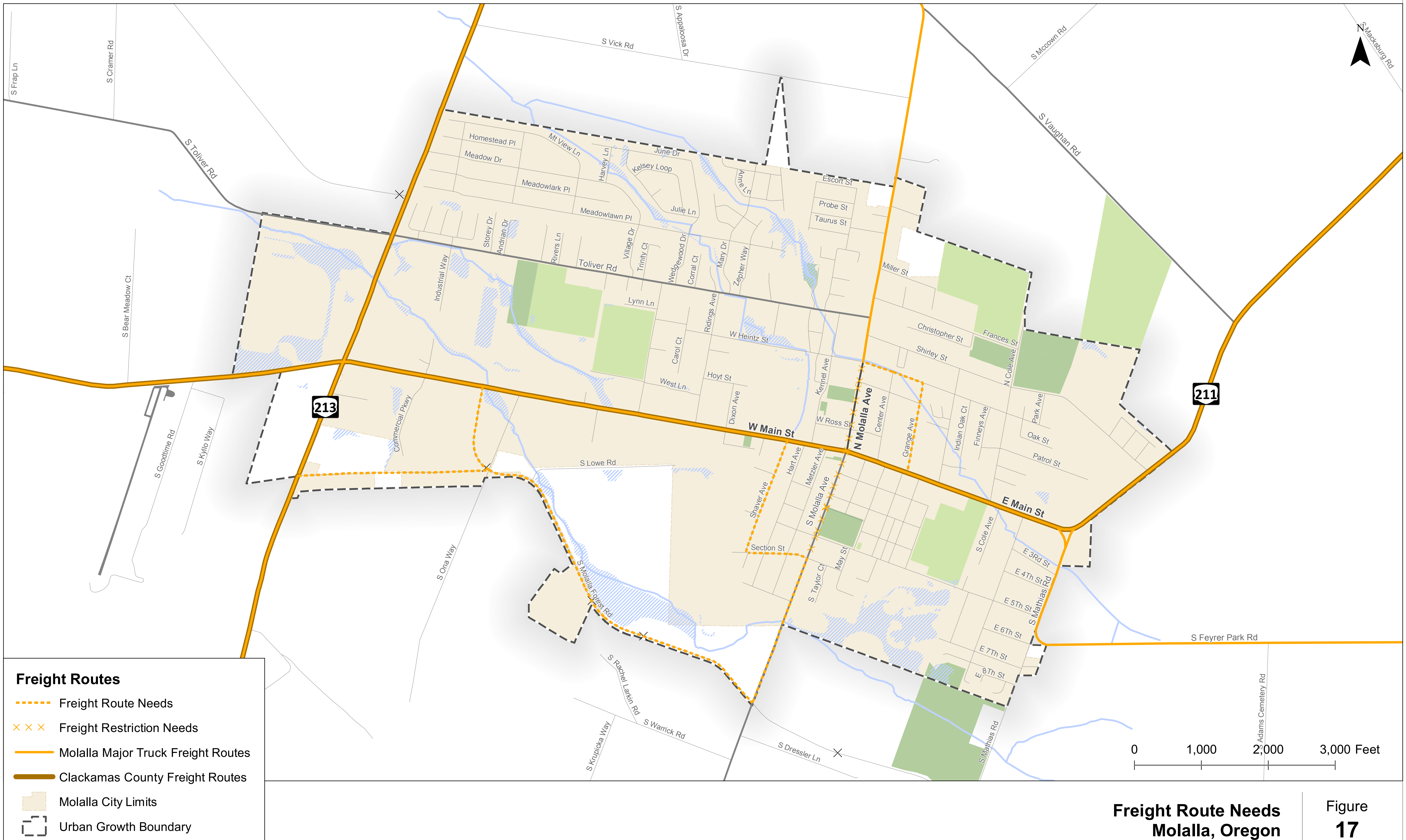
Freight Needs

As indicated in *Tech Memo 4: Existing Transportation System*, there are no state designated freight routes within Molalla. However, the Clackamas County TSP identifies OR 213 and OR 211 as truck freight routes and the current Molalla TSP identifies OR 213 and OR 211 along with Molalla Avenue, Mathias Road, and Feyrer Road as the main truck freight routes within the city

The RTP identifies five policies to serve as the foundation for the regional freight network, including 1) Use a system approach to plan for and manage the freight network; 2) Reduce delay and increase reliability; 3) Protect industrial lands and freight transportation investments; 4) Look beyond the roadway network to address critical marine and rail needs; and 5) Pursue clean, green and smart technologies and practices.

Freight movement within the city consists of commercial freight traffic traveling through the city along OR 213 and OR 211, the delivery of goods to the retail/commercial areas along OR 211 and Molalla Avenue, and the delivery and shipment of raw materials to/from the industrial areas along the south side of OR 211.

Therefore, the primary freight needs are minimizing conflicts between freight vehicles and other modes along freight routes; reducing congestion along OR 211 and at the OR 213/OR 211 and Molalla Avenue/OR 211 intersections to ensure the continuous movement of goods; and ensuring adequate access to/from retail/commercial areas along OR 211 and Molalla Avenue, as well as the industrial areas along the south side of OR 211. Figure 17 illustrates the freight needs within Molalla. These needs will most likely be addressed by the designation of a freight route system within Molalla, which may include restrictions along sections of Molalla Avenue and provisions in other areas to accommodate freight movement. More detailed recommendations for these measures will be identified in subsequent project memos.



Freight Route Needs
Molalla, Oregon

Figure
17

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KITTELSON & ASSOCIATES

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Source: Metro Data Resource Center, City of Molalla

OTHER TRAVEL MODES NEEDS

Rail

As indicated in *Tech Memo 4: Existing Transportation System*, there are no freight rail or passenger rail terminals within Molalla. The closest terminals are located approximately 20 miles to the north in Oregon City. Therefore, the needs associated with the rail travel include ensuring adequate access to/from the freight and passenger rail terminals in Oregon City by all (feasible) travel modes. This need will be addressed through the identification of improvements to the public transit, pedestrian, bicycle, motor vehicles systems within the city.

Air

As indicated in *Tech Memo 4: Existing Transportation System,* there are no airports within Molalla. The closest airports are the Mulino Airport, located approximately five mile to the north along OR 213 in Mulino, OR, and the Skydive Airport, located less than one mile to the west along OR 211. The Portland International Airport is also located approximately 35 miles to the north. Therefore, the needs associated with air travel include ensuring adequate access to/from the airports by all (feasible) travel modes. This need will be addressed through the identification of improvements to the public transit, pedestrian, bicycle, motor vehicles systems within the city.

Water

As indicated in *Tech Memo 4: Existing Transportation System,* there are no navigable waterways within Molalla. However, the Molalla River, which runs south to north along the eastern boundary of the city, is used year round by local residents for recreational purposes. Access to the rivers is provided by Feyrer Park, located approximately 3 miles southeast of the City, as well as several formal and informal accesses along OR 211 and the Molalla Forest Road. Therefore, the needs associated with water include ensuring adequate access to/from the Feyrer Park and other accesses. This need will be addressed through the identification of improvements to the public transit, pedestrian, bicycle, motor vehicles systems within the city.

Pipeline

There are currently no needs associated with pipelines.

TRANSPORTATION SYSTEM MANAGEMENT OPERATIONS

Transportation System Management and Operations (TSMO) measures are designed to increase the efficiency and safety of the transportation system without physically increasing roadway capacity. Typical TSMO measures include Intelligent Transportation System (ITS) solutions, real-time traveler information, and services that respond quickly to traffic incidents. Several TSMO strategies are identified in Attachment A and will be further evaluated in *Tech Memo 6: TSP Solutions.*

TRANSPORTATION DEMAND MANAGEMENT

Transportation Demand Management (TDM) strategies measures typically include any method intended to shift travel demand from single occupant vehicles to non-auto modes or carpooling, travel at less congested times of the day, etc. Several TDM strategies are identified in Attachment A and will be further evaluated in *Tech Memo 6: TSP Solutions.*

Attachment A Menu of Solutions

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PORTLAND, OR 97205
P 503.228.5230 F 503.273.8169

MEMORANDUM

Date: March 23, 2018 Project #: 21266.0

To: Gerald Fisher and Dan Huff, City of Molalla
Gail Curtis, Oregon Department of Transportation

From: Matt Bell and Nick Gross, Kittelson & Associates, Inc.

Project: Molalla Transportation System Plan (TSP) Update

Subject: Menu of Potential Solutions

This memorandum summarizes a range of potential transportation-related solutions that can be used guide the city as it grows and redevelops in the future. These "toolbox" measures fall into the following categories:

- Active transportation
- Connectivity
- Intersection control
- Neighborhood traffic management
- Transportation system management and operations
- Land use

The potential solutions included in this toolbox are intended to help the city maximize its investment in the existing infrastructure and enhance the quality and availability of pedestrian, bicycle, transit, and motor vehicle facilities, as well as plan for the long-term transportation needs of the community.

ACTIVE TRANSPORTATION

One of the city's priorities is to reduce the reliance of single occupancy vehicles for local trips by providing residents with the option to walk, bike, or take transit to their destination. The provision of pedestrian and bicycle facilities between key destinations as well as the implementation of other active transportation strategies can enable the community to establish a well-connected system that promotes walking, bicycling, and taking transit.

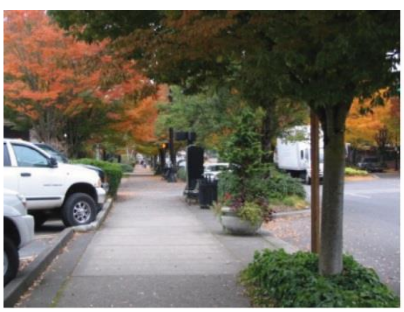
Pedestrian Facilities

Pedestrian facilities are the elements of the transportation system that enable people to walk safely and efficiently between neighborhoods, retail/commercial centers, employment areas, and transit stops. These include facilities for pedestrian movement along key roadways (e.g., sidewalks, shared use paths and trails) as well as for safe roadway crossing locations (e.g., crosswalks, crossing beacons, pedestrian refuge islands). Each plays a role in developing a comprehensive pedestrian network.

A few of the city's arterial and collector streets currently lack pedestrian facilities. Others have facilities that are deficient or do not provide a comfortable environment for most pedestrians. In the future, as arterial and collector streets are improved, most of these streets will include sidewalks and/or shared-use paths alongside the roadway. Pedestrian improvements should be prioritized based on their ability to complete connections between places that generate walking trips such as residential neighborhoods and schools, parks, retail/commercial center, and transit stops. Shared-use path projects are discussed in a subsequent section because of their utility for both pedestrians and bicyclists.

Sidewalks

Sidewalks are the fundamental building blocks of the pedestrian system. They enable people to walk comfortably, conveniently and safely from place to place. They also provide an important means of mobility for people with disabilities and families with strollers, and others who may not be able to travel on an unimproved roadside surface. Sidewalks are usually constructed from concrete and they provide an area separated from the roadway by a curb, landscaping, and/or on-street parking. Sidewalks are widely used in urban and suburban settings. The images below show sidewalks in a variety of urban and suburban settings.



Types of Pedestrian Crossings

Crossing facilities enable pedestrians to safely cross streets, railroad tracks, and other transportation facilities. Planning for appropriate pedestrian crossings requires the community to balance vehicular mobility needs with providing crossing locations that are located along the desired routes of walkers.

The state of Oregon considers all roadway intersections to be legal crossing locations for pedestrians regardless of whether a painted crosswalk is provided. At these locations, drivers are required to yield the right of way to pedestrians to allow them to cross. Driver compliance to yielding is often inconsistent and pedestrians often have difficulty crossing higher volume and higher speed roadways. There are several different types of pedestrian crossing treatments; each of which is applicable under a different range of considerations.

A brief description of the various pedestrian crossing types and where they can be applied is provided below.

High Visibility Crosswalk

Clear, reflective roadway markings and accompanying devices are placed at intersections and priority pedestrian crossings where there is sufficient sight distance and reaction time for motorists to yield. Crosswalks can be used at intersections and at mid-block crossings.

Raised Crosswalk

A raised crosswalk is raised higher than the surface of the street to give motorists and pedestrians a better view of the crossing area. A raised crosswalk is similar to a speed table and are often marked and signed for pedestrian crossing. Raised crosswalks are often used in areas with low speeds where people and difficulty crossing the street.

Raised Pedestrian Refuge

A raised median island provides a protected area in the middle of a crosswalk for pedestrians to stop while crossing the street. These refuges allow pedestrians to cross one direction of traffic at a time. Pedestrian refuges are often used in areas with high traffic volumes and/or at locations with a crash history involving pedestrians.

In-Street Yield

“Yield to Pedestrian” signs can be placed in the middle of crosswalks to increase driver awareness of crossing locations and the legal responsibility to yield right-of-way to pedestrians crossing the street. These signs can be effective in areas that experience high volumes of pedestrian crossings and low levels of motorist yielding rates.

Grade-Separated Crossing

Grade-separated crossings are either underpasses or overpasses that allow pedestrians to entirely avoid conflicts with automobiles when crossing a busy roadway. When used as part of a shared-use path, grade-separated crossings also accommodate bicycles. Grade-separated crossings are necessary wherever pedestrian crossings of freeways are constructed and in other limited circumstances, such as railroad crossings. However, they are often perceived as unsafe (especially under-crossings), and may result in significant out-of-direction travel for pedestrians. Grade-separated crossings can also be very expensive to build and are typically used sparingly.

Rapid Rectangular Flashing Beacon (RRFB)

These crossing treatments include signs that have a pedestrian-activated “strobe-light” flashing pattern to attract motorists’ attention and provide awareness of pedestrians that are intending to cross the roadway. RRFBs are often used in areas with high volumes of pedestrians desiring to cross a street at a mid-block location.

Pedestrian Hybrid Beacon (HAWK)

A HAWK is a pedestrian-activated signal that is unlit when not in use. When activated the signal begins with a yellow light alerting drivers to slow and then a solid red light appears requiring drivers to stop while pedestrians have the right-of-way to cross the street. HAWKs are often used on wide roadways where mid-block crossings are difficult.

Bicycle System

Bicycle facilities enable cyclists to travel safely and efficiently on the transportation system. Both public infrastructure (bicycle lanes, shared roadways, shared-use paths and trails, signing and striping) and “on-site” facilities (secure parking, changing rooms, and showers at worksites) are important to providing a comprehensive bicycle system.

Many different bicycle facility types are needed to create a complete bicycle system that connects people to their destinations and allows cyclists to feel comfortable and safe while riding. While there are some bicycle lanes along select arterial and collector streets within the city, these lanes are not provided along the entire lengths of the corridors. The existing network could be supplemented by additional bicycle lanes or other types of bicycle facilities.

Types of Bicycle Facilities

Several types of bicycle facilities are discussed below.

Bike Lanes

Bike lanes are on-street bicycle facilities that provide a designated space for cyclists that is separated from vehicle traffic by pavement markings. Bike lanes are generally used on collector and arterial streets with adequate space to accommodate the bike lane width and with vehicular travel volumes and speeds that make it difficult for drivers and cyclists to "share the road." Bike lanes typically include white striping with a bicycle symbol or they can be buffered as shown below.

Buffered Bike Lanes

Buffered bike lanes are on-street bike lanes that include a physical separation ("buffer") between the bike lane and the vehicle traffic lane and/or the vehicle parking lane. Buffered bike lanes can be particularly helpful on streets with high vehicle speeds, high vehicle volumes, or relatively frequent parking turnover.

Cycletracks

Cycletracks are exclusive bikeways separated from vehicle travel lanes, parking lanes and sidewalks. They can be one- or two-way in direction and can be even with the street, the sidewalk, or somewhere between. On existing streets, cycletracks can be constructed where there is sufficient roadway width and/or in contexts where the number of vehicular travel lanes can be reduced.

Sharrows

A shared-lane pavement marking, or sharrow, is a pavement marking that can be used where space does not allow for a bike lane and/or where vehicular volumes and travel speeds allow cyclists to comfortably and conveniently "share the road" with motorists. Sharrows remind motorists of the presence of bicycles and indicate to cyclists where to safely ride within the roadway.

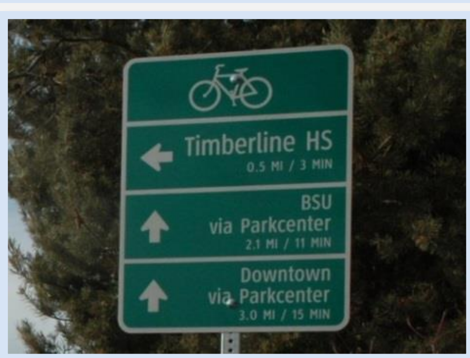
Low-Traffic Bikeway

Also known as "bicycle boulevards," streets with low vehicular volumes and speeds can be optimized for bicycle travel by including treatments for traffic calming and traffic reduction, signage and pavement markings, and intersection crossing treatments. Bike boulevards are ideal on local streets that parallel larger, high traffic routes and provide connections to similar destinations.

Mixed-Use Shoulder

A mixed-use shoulder is a roadway shoulder that is wide enough to be used by pedestrians and bicyclists as a mixed-use path. Mixed-use shoulders are ideal on low-volume streets where topography or the surrounding environment does not allow for the addition of a sidewalk or separate bicycle facility.

Wayfinding Signage



Wayfinding signs can direct bicyclists and pedestrians towards key destinations both within the city as well as to neighboring communities. These signs often include the distance to the destination and/or average travel times. Wayfinding signs are generally used on primary bicycle routes and multi-use trails.

“Share the Road” Signs

“Share the Road” signs can be used to remind drivers to watch for bicyclists on roadways without on-street bicycle lanes. However, the signs are not meant as a replacement for using the other facility types listed in this table. An alternative to the “Share the Road” sign is a “Bikes in Road” sign that suggests bicyclists take the lane rather than share the road.

Bicycle Crossings

Bicycle crossing treatments connect bike facilities at high traffic intersections, trailheads, or other bike routes. Frequently used crossing treatments are shown below.

Marked Bicycle Detectors at Traffic Signals

Many traffic signals are “actuated”, meaning that a green light is provided to a particular intersection approach only when a vehicle is detected on that approach. However, actuating a signal as a cyclist is difficult if no indication is given of the location of detection equipment. Pavement markings can show cyclists where to stand to actuate a signal. Additionally, the sensitivity of all traffic signal loop detectors can be set to allow for bicycle activation. At intersections where bicyclists wait in areas separate from traffic, specific bicycle detectors can be installed.

Bicycle-only Signal

Bicycle-only signals can be used at intersections to provide a separate signal phase that is dedicated to bicyclists. They are especially useful at roadway intersections with multi-use trails, where there are high volumes of bicyclists crossing, or at intersections where large numbers of right-turning vehicles have the potential to conflict with through bicycles.

Preferential Movement for Bicycles

Some intersections may be designed such that cars cannot make particular movements, but bicyclists can. This type of treatment allows greater connectivity for bicyclists.

Striping Through Intersections

At high-vehicle and/or high-bicycle volume intersections, extending bicycle lane striping through the intersection can alert drivers to look out for bicyclists traveling through the intersection and help bicyclists know where to proceed with crossing.

On-Site Facilities

Bicyclists also benefit from facilities that are located on-site within key employment, commercial and institutional locations. These facilities can include indoor and/or outdoor secure bicycle parking, open or covered U-shaped racks, showers/changing rooms, and storage lockers for clothing and gear. The City can use incentives to encourage developers to include these types of facilities in new buildings.

Shared-use Pathways

Paved, bi-directional shared-use pathways can be designed as part of a Park and Recreational System and/or can be constructed adjacent to roadways where the topography, right-of-way, or other issues don’t allow for the construction of sidewalks and bike facilities.

Intersections of shared-use paths and roadways require crossing treatments that are well-marked and highly visible to vehicles and trail users. Shared-use paths can be used to create longer-distance links within and between communities, provide regional connections and play an integral role in recreation, commuting, and accessibility for residents due to their broad appeal to users of all ages and skill levels.

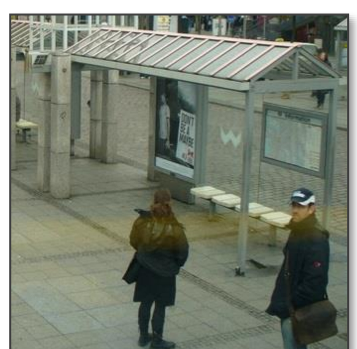
Shared-use paths provide a comfortable space for pedestrians and bicyclists of all ages.

The City may use shared-use paths in lieu of sidewalks and bike facilities, where appropriate.

Public Transit

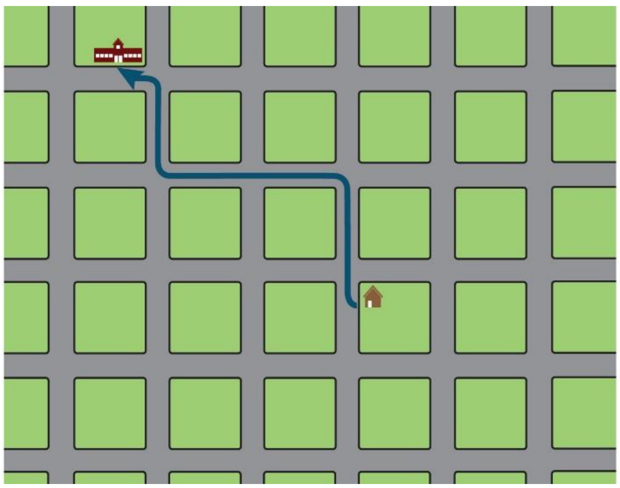
Public transit can provide important connections to destinations for people that do not drive or bike and can provide an additional option for all transportation system users for certain trips. Public transit can also provide links to walking, bicycling, or driving trips: users can walk to and from transit stops and their homes, shopping or work places, people can drive to park-and-ride locations to access a bus, or people can bring their bikes on transit vehicles and bicycle from a transit stop to their final destination.

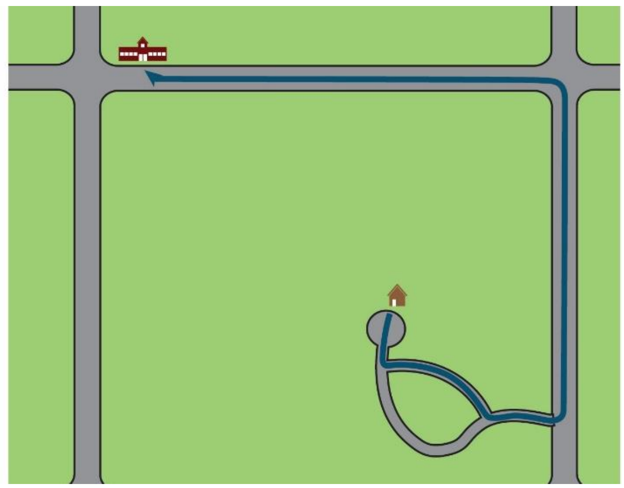
Providing transit service in smaller cities is generally led by a local or regional transit agency, and is dependent on having the land use and densities that can support service. The city can plan for transit-supportive land use patterns and support future transit viability by designing and building streets that will comfortably accommodate transit stops and include the right-of-way that could allow for transit stops to be located as close as possible to important destinations in the city. At a minimum, a transit stop should be well-signed and have a comfortable space to wait. Benches that prove people with a place to sit and shelters that protect people from the weather can improve user comfort. Including bike parking near bus stops allows people the option to leave their bike at one trip-end instead of bringing it on the bus.



CONNECTIVITY

A well connected grid network of streets provides for convenient travel for vehicles, pedestrians and cyclists. Given an equivalent number of roadway lane-miles, a connected system generally has more capacity than a disconnected road network and provides the shortest, most direct routes for all users. A grid network can also lessen the effects of congestion along a single route, due to the number of alternate routes available. A connected system also can create easier and more expedient emergency response and can encourage pedestrians and bicyclists, who benefit greatly from having a direct route due to generally slower travel speeds. The images below show how someone might travel between their home and school on a well-connected grid network versus one that is a system of cul-de-sacs.





The left illustration is a connected street grid, on the right is a less connected system. Travel distance from home to school is shorter in a connected system.

The older parts of Molalla are largely built on a grid system, while the newer parts are largely built on a system of cul-de-sacs and dead ends. These streets can be desirable to residents because they can limit traffic speeds and volumes on local streets, but cul-de-sacs and dead ends result in longer trip distances, increased reliance on arterials for local trips, and limited options for people to walk and bike to the places they want to go.

The future street system needs to balance the benefits of providing a well-connected grid system with physical and topographical challenges. Incremental improvements to the street system can be planned carefully to provide route choices for motorists, cyclists and pedestrians while accounting for potential neighborhood impacts. In addition, the quality of the transportation system can be improved by making connectivity improvements to the pedestrian and bicycle system separate from street connectivity.

INTERSECTION CONTROL

The Oregon Department of Transportation (ODOT) maintains the traffic signal located at the OR 213/OR 211 intersection. The rest of the intersections in the city are stop-controlled. The majority of these are two-way stop controlled (TWSC), with the stop sign provided on the lower volume of the two intersecting roadways. In the future, increasing traffic volumes may warrant different intersection options, such as roundabouts, traffic signals, and all-way stop control. The type of intersection control and final design for each intersection will need to consider the desired function of the roadways, travel speeds, safety, pedestrian and bicycle needs, topography, anticipated traffic volumes, sight distance, available space and other potential constraints and opportunities.

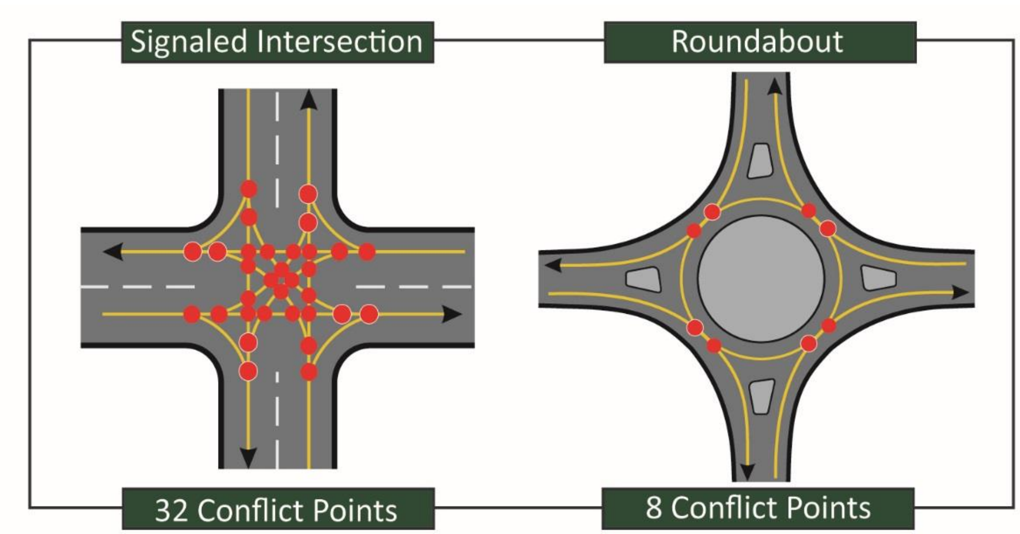
All-way Stop-control

All-way stop control is often used when the two intersecting roadways have similar vehicular volumes and where a traffic signal or roundabout is not needed. All-way stop control intersections are relatively inexpensive and can be implemented more easily than traffic signals and roundabouts.

Roundabout

Roundabouts are circular intersections where entering vehicles yield to vehicles already in the circle. They are designed to slow vehicle speeds to 20 to 30 mph or less before they enter the intersection. As shown below, roundabouts have fewer conflict-points and have been shown to reduce the severity of crashes, as compared to signalized intersections. Roundabouts can be more costly to design and install when compared to other intersection control types, but they have a lower operating and maintenance cost than traffic signals. Topography must be carefully evaluated in considering a roundabout, given that slope characteristics at an intersection may render a roundabout infeasible.

Roundabouts have fewer conflict points than signalized intersections.



Depending on the design, roundabouts can be more land-intensive than other intersection controls. To maintain the flexibility to construct roundabouts at key intersections, the City may want to ensure adequate right-of-way is provided at intersection locations whenever right-of-way dedication or acquisition activities are undertaken. Information contained in the City's development code and engineering standards can account for this need.

Key intersections of arterial/arterial, arterial/collector, and collector/collector streets may be candidates for roundabout installation in the future. Within Molalla, a majority of these locations could likely be well served by a single lane roundabout. Based on national guidance, the right-of-way dedication at these locations could include a circle with a radius of 85 feet measured from the center of the intersection, to preserve space for a single-lane roundabout, sidewalk, and landscaping in a 170-foot diameter circle. On intersections along key freight routes within the city, a 95-foot radius (190 feet in diameter) circle could be preserved.

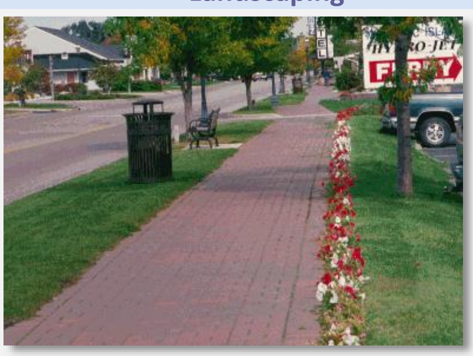
Traffic Signals

Traffic signals allow opposing streams of traffic to proceed in an alternating pattern. Both national and state guidance indicates when it is appropriate to install traffic signals at intersections. When used, traffic signals can effectively manage high traffic volumes, and provide for dedicated times in which pedestrians and cyclists can cross roadways. Because they continuously draw from a power source and must be periodically re-timed, signals typically have higher maintenance costs than other types of intersection control. Signals can improve safety at intersections where signal warrants are met, however, signals may result in a shift to higher levels of rear-end crashes compared to alternatives.

NEIGHBORHOOD TRAFFIC MANAGEMENT

Neighborhood Traffic Management (NTM), also known as "traffic calming," describes traffic control devices typically used in residential neighborhoods to slow traffic or possibly reduce the volume of traffic. Below are illustrations and descriptions of neighborhood traffic management strategies that could be applied in Molalla to address traffic issues that arise over time.

Speed Wagon	Pros	Cons
	▪ Inexpensive ▪ Low operating costs ▪ Mobile	▪ Penalties for speeding not enforced ▪ Not permanent ▪ Placement may obstruct bicycle lane or shoulder

Speed Humps	Pros	Cons
	▪ Permanent ▪ Can be used to provide raised pedestrian crossings ▪ Can be modified to accommodate emergency vehicles	▪ Placement of speed humps can be contentious ▪ Requires maintenance
Traffic Circles	**Pros**	**Cons**
	▪ Can have aesthetic value ▪ Physical barrier encourages lower speeds	▪ Can impede emergency vehicles or freight/delivery truck movement ▪ Increased maintenance costs
Medians	**Pros**	**Cons**
	▪ Eliminates potential conflict points ▪ Provides pedestrian refuge ▪ Can benefit access management	▪ Can be more expensive to construct than other NTM measures ▪ Can impede roadway connectivity ▪ Can impact business access
Landscaping	**Pros**	**Cons**
	▪ Aesthetic value ▪ Provides buffer for pedestrians ▪ Can have traffic calming effect	▪ Requires additional maintenance, including weed management ▪ Requires additional right-of-way allocation ▪ Can impede sight distance

Curb Extensions	Pros	Cons
	▪ Reduces pedestrian crossing distance ▪ Can have a traffic calming effect	▪ Can be expensive to construct ▪ Can impede freight movements

Choker	Pros	Cons
	▪ Can be used in conjunction with a midblock pedestrian crossing ▪ Can have traffic calming affect	▪ Expensive to construct

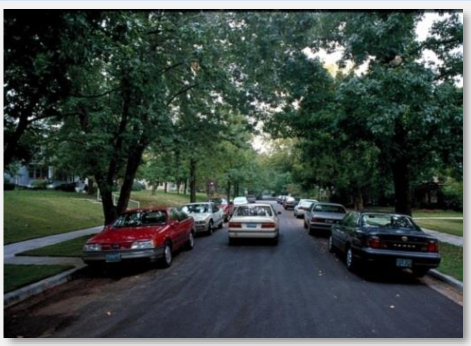
Narrow Streets	Pros	Cons
	▪ Reduces pedestrian crossing distance ▪ Can have a traffic calming effect ▪ Less asphalt to maintain	▪ Can impede emergency vehicles ▪ Can limit availability of on-street parking

Photo Radar	Pros	Cons
	▪ Permanent speed enforcement ▪ Strong deterrent for excessive speeds	▪ Expensive initial investment required ▪ Not portable

On-Street Parking	Pros	Cons
	▪ Increases available parking for commercial and/or residential uses ▪ Narrows feel of the street ▪ Potential revenue source when metered	▪ Adequate right-of-way must exist or be created ▪ Can conflict with bicycle lanes ▪ Can create additional conflict points for vehicles ▪ Can reduce sight distance

Selective Enforcement	Pros	Cons
	▪ Mobile ▪ Can target identified problem areas	▪ Requires allocation of enforcement resources ▪ May only result in temporary improvement in motorist compliance with posted speeds

Partial Street Closures	Pros	Cons
	▪ Lack of direct through routes for vehicles can reduce speeds ▪ Maintain connectivity for bicycles and pedestrians	▪ Can create connectivity issues, counter to TSP goals ▪ May increase speeds on alternative routes ▪ May increase volumes on alternative routes

Traffic calming should be considered in an area-wide manner to avoid shifting impacts between neighborhoods and adjacent streets. Typically, traffic calming receives a favorable reception by residents adjacent to streets where vehicles travel at speeds above 30 miles per hour. However, traffic calming can also be contentious because it may be perceived as just moving the problem from one neighborhood to another rather than solving it. Traffic calming may also be perceived as impacting emergency vehicle travel.

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS (TSMO)

Transportation Demand Management (TDM) and Transportation System Management (TSM) strategies are two complementary approaches to managing transportation and maximizing the existing system. Together, these strategies are referred to as Transportation System Management and Operations (TSMO). TDM addresses the *demand* on the system: the number of vehicles traveling on the roadways each day. TDM measures include any method intended to shift travel demand from single occupant vehicles to non-auto modes or carpooling, travel at less congested times of the day, etc. TSM addresses the *supply* of the system: using strategies to improve the system efficiency without increasing roadway widths or building new roads. TSM measures are focused on improving operations by enhancing capacity during peak times, typically with advanced technologies to improve traffic operations.

The following section provides an overview of a broad range of TSMO measures that could be considered for implementation in Molalla and explains those that are most applicable.

TSMO Strategies

Successful implementation of TSMO strategies relies on the participation of a variety of public and private entities. Strategies can be implemented by a region, a city, a neighborhood, or particular employer. In addition, they can be categorized as policies, programs, or physical infrastructure investments. Table 1 provides a summary of potential measures that can be implemented within the Metro region and which entities are generally in the position to implement each one. As the city continues to grow and redevelop over the next 20 to 40 years, the applicability of these strategies can be further reviewed. Additional information on potential strategy implementation within Molalla is discussed below.

Table 1: Transportation System Management (TSM) and Transportation Demand Management (TDM) strategies

TSMO Strategy	TDM or TSM?	Type of Investment	City/ County/ Region	Transportation Management Association[1]	Developers	Transit Provider	Employers	State
Parking management	TSM / TDM	Policy	P		S	S	S	
Limited/flexible parking requirements	TDM	Policy	P		S		S	
Access management	TSM / TDM	Policy / Infrastructure	P					P
Connectivity standards	TSM / TDM	Policy / Infrastructure	P		S			P
Congestion pricing	TSM / TDM	Policy / Infrastructure	P					P
Flexible Work Shifts	TDM	Program / Policy	S				P	
Frequent transit service	TDM	Program	S			P		
Free or subsidized transit passes	TDM	Program	S				P	
Preferential carpool parking	TDM	Program	S				P	
Carpool match services	TDM	Program	S	P			S	
Parking cash out	TDM	Program		S		S	P	
Carsharing program support	TDM	Program	P	S	P	P	P	
Bicycle facilities	TDM	Infrastructure	P		S		S	S
Pedestrian Facilities	TDM	Infrastructure	P		S			
Regional ITS	TSM	Infrastructure	P					
Regional traffic management	TSM	Infrastructure	P					
Advanced signal systems	TSM	Infrastructure	P			S		
Real time traveler data	TSM	Infrastructure	P					P
Arterial corridor management	TSM	Infrastructure	P					

[1]A Transportation Management Association does not currently exist in Molalla
P: Primary role
S: Secondary/Support role
* Primary implementation depends on roadway jurisdiction

Strategies for Molalla

The following section provides more detail on policy, programming and infrastructure strategies that may be effective for managing transportation demand and increasing system efficiency in Molalla, especially within the next 10 to 20 years.

Programming

Programming solutions can provide effective and low cost options for reducing transportation demand. Some of the most effective programming strategies can be implemented by employers and are aimed at encouraging non-single occupancy vehicle (SOV) commuting. These strategies are discussed below.

Carpool Match Services

Metro coordinates a rideshare/carpool program (see the DriveLessConnect.com website) that regional commuters can use to find other commuters with similar routes to work. The program allows commuters to connect and coordinate with others on locations, departure times, and driving responsibilities. Employers can also play a role in encouraging carpooling by sharing information about the system, providing preferential carpool parking, and allowing employee flexibility in workday schedules.

Collaborative Marketing

Cities, employers, future transit service providers, and developers can collaborate on marketing to get the word out to residents about transportation options that provide alternatives to single-occupancy vehicles.

Policy

Policy solutions can be implemented by cities, counties, regions, or at the statewide level. Regional and state-level policies will affect transportation demand in Molalla, but local policies can also have an impact.

Limited and/or Flexible Parking Requirements

Cities set policies related to parking requirements for new developments. In order to allow developments that encourage multi-modal transportation, cities can set parking maximums and low minimums and/or allow for shared parking between uses. Cities can also provide developers the option to pay in-lieu fees instead of constructing additional parking. This option provides additional flexibility to developers that can increase the likelihood of development, especially on smaller lots where surface parking would cover a high portion of the total property.

Finally, cities can set policies that require provision of parking to the rear of buildings, allowing buildings in commercial areas to directly front the street. This urban form creates a more appealing environment for walking and window-shopping. In-lieu parking fees support this type of development for parcels that do not have rear- or side-access points.

Parking Management

Parking plays a large role in transportation demand management, and effective management of parking resources can encourage use of non-single occupancy vehicle modes. Cities can tailor policies to charge for public parking in certain areas and impose time limits on street parking in retail centers. Cities can also monitor public parking supply and utilization in order to inform future parking strategy.

Access Management

Access management describes a practice of managing the number, placement, and movements of intersections and driveways that provide access to adjacent land uses. Access management policies can be an important tool to improve transportation system efficiency by limiting the number of opportunities for turning movements on to or off of certain streets.

In addition, well deployed access management strategies can help manage travel demand by improving travel conditions for pedestrian and bicycles. Eliminating the number of access points on roadways allows for continuous sidewalk and bicycle facilities and reduces the number of potential interruptions and conflict points between pedestrians, bicyclists, and cars.

Access management is typically adopted as a policy in development guidelines. It can be extremely difficult to implement an access management program once properties have been developed along a corridor. Cooperation among and involvement of relevant government agencies, business owners, land developers and the public is necessary to establish an access management plan that benefits all roadway users and businesses.

Signal Systems Improvements

Signal retiming and optimization offer a relatively low cost option to increase system efficiency. Retiming and optimization refers to updating timing plans to better match prevailing traffic conditions and coordinating signals. Timing optimization can be applied to existing systems or may include upgrading signal technology, such as signal communication infrastructure, signal controllers, or cabinets. Signal retiming can reduce travel times and be especially beneficial to improving travel time reliability. In high pedestrian or desired pedestrian areas, signal retiming can facilitate pedestrian movements through intersections by increasing minimum green times to give pedestrians time to cross during each cycle, eliminating the need to push pedestrian crossing buttons. Signals can also facilitate bicycle movements with the inclusion of bicycle detectors.

Signal upgrades often come at a higher cost and usually require further coordination between jurisdictions. However, upgrading signals provides the opportunity to incorporate advanced signal systems to further improve the efficiency of a transportation network. Strategies include coordinated signal operations across jurisdictions, centralized control of traffic signals, adaptive or active signal control, and transit or freight signal priority. These advanced signal systems can reduce delay, travel time and the number of stops for transit, freight, and other vehicles. In addition, these systems may help reduce vehicle emissions and improve travel time reliability.

Transit signal priority systems use sensors to detect approaching transit vehicles and alter signal timings to improve transit performance. This improves travel times for transit, reliability of transit travel time, and overall attractiveness of transit. The City of Portland has one of the only systems of transit signal priority in the region, which is applied on most of the major arterial corridors throughout the city.

Adaptive or active signal control systems improve the efficiency of signal operations by actively changing the allotment of green time for vehicle movements and reducing the average delay for vehicles. Adaptive or active signal control systems require several vehicle detectors at intersections in order to detect traffic flows adequately, in addition to hardware and software upgrades.

Traffic responsive control uses data collected from traffic detectors to change signal timing plans for intersections. The data collected from the detectors is used by the system to automatically select a timing plan best suited to current traffic conditions. This system is able to determine times when peak-hour timing plans begin or end; potentially reducing vehicle delays.

Truck signal priority systems use sensors to detect approaching heavy vehicles and alter signal timings to improve truck freight travel. While truck signal priority may improve travel times for trucks, its primary purpose is to improve the overall performance of intersection operations by clearing any trucks that would otherwise be stopped at the intersection and subsequently have to spend a longer time getting back up to speed. Implementing truck signal priority requires additional advanced detector loops, usually placed in pairs back from the approach to the intersection.

Real-Time Traveler Information

Traveler information consists of collecting and disseminating real-time transportation system information to the traveling public. This includes information on traffic and road conditions, general public transportation and parking information, interruptions due to roadway incidents, roadway maintenance and construction, and weather conditions. Traveler information is collected from roadway sensors, traffic cameras, vehicle probes, and more recently, media access control (MAC) devices such as cell phones or laptops. Data from these sources are sent to a central system and subsequently disseminated to the public so that drivers track conditions specific to their cars and can provide historical and real-time traffic conditions for travelers.

When roadway travelers are supplied with information on their trips, they may be able to avoid heavy congestion by altering a travel path, delaying the start of a trip, or changing which mode they can choose. This can reduce overall delay and fuel emissions. Traveler information projects can be prioritized over increasing capacity on roadway, often with high project visibility among the public.

Real-Time Transit Information

Transit agencies or third-party sources can disseminate both schedule and system performance information to travelers through a variety of applications, such as in-vehicle, wayside, or in-terminal dynamic message signs, as well as the Internet or wireless devices. Coordination with regional or multimodal traveler information efforts can increase the availability of this transit schedule and system performance information. TriMet has implemented this through its Transit Tracker system. These systems enhance passenger convenience and may increase the attractiveness of transit to the public by encouraging travelers to consider transit as opposed to driving alone. They do require cooperation and integration between agencies for disseminating the information.

LAND USE

The types and intensities of land uses are closely correlated with travel demand. Land use patterns in many areas of the city are suburban in nature and low density, with more moderate densities with the downtown area. In the future, the city is envisioned to be a mixture of housing densities and areas of mixed use development (i.e., a mix of residential, retail, commercial and/or office uses).

Commercial Nodes in Residential Areas

Commercial nodes in residential areas provide residents with the opportunity to walk or ride their bike for non-work related trips. Neighborhood commercial nodes can include small restaurants, coffee shops, hair salons or other neighborhood retail or personal service uses. The city's zoning map currently shows a limited number of commercial notes within the city outside from those located along OR 211 and Molalla Avenue.

As future nodes develop, the City can encourage individual business to share parking to provide for the more efficient use of land and reduce land, development and maintenance concepts. Nodal development and shared parking allows people to drive, bike, or take transit to one location and then comfortably walk between businesses.

Mixed Use Development

Mixed use developments can reduce automobile trips by supporting higher frequency transit service and promoting pedestrian and bicycle travel. Urban areas with mixed uses and higher densities can be promoted in targeted areas, such as the four main general commercial areas and/or future town centers. Creating new employment areas near existing and future residential areas in Molalla also can create opportunities for people to live closer to where they work.

Attachment B Population and Employment Forecast Methodology

LAND USE PLANNING
TRANSPORTATION PLANNING
PROJECT MANAGEMENT

MEMORANDUM

Population and Employment Forecast Methodology

City of Molalla, OR Transportation System Plan Update

DATE	March 21, 2018
TO	Molalla TSP Update Project Management Team
FROM	Matt Hastie and Andrew Parish, Angelo Planning Group
CC	

INTRODUCTION

This memorandum describes land use scenarios for the City of Molalla Transportation System Plan (TSP) update, and the methodology behind each scenario. This forecast will ultimately provide the following:

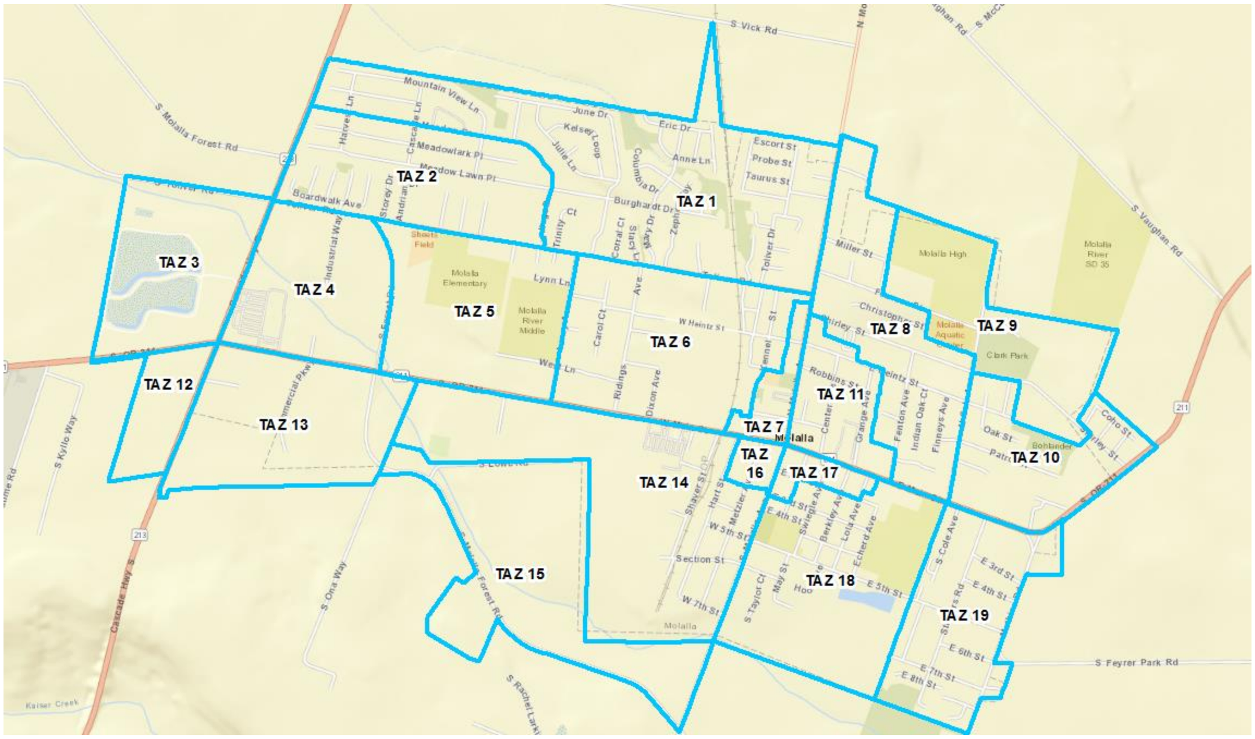
- Number of single family detached (SFD), single family attached (SFA), and multifamily (MF) housing units in each Transportation Analysis Zone (TAZ), current year (2017) and end year (2040).
- Square footage of employment uses (as categorized by the draft Molalla Economic Opportunities Analysis), current year and end year

In order to create a reasonable traffic model for the TSP update, three distinct scenarios are used. The first scenario assumes that some portion of growth will occur within the City of Molalla's current Urban Growth Boundary (UGB), and the remainder will occur outside the current UGB. This scenario does not consider the location of any future growth outside the existing UGB, and relies on an assessment of the estimated capacity within the current UGB, using existing land use designations, to accommodate future growth. In general, this scenario assumes that future development will occur at the higher end of allowed densities, while densities of actual development ultimately may be lower than allowed. Therefore, this scenario represents a conservative analysis of the impacts of future growth on the transportation system.

In addition, a second land use scenario was developed as a sensitivity analysis. This scenario assumes that all expected growth will occur within the existing UGB. The location of this growth was apportioned to the TAZs in a simple proportional method described later in this memorandum. This scenario is not intended to be a realistic assessment of the development potential of the City. However, it will provide insight into how the transportation system generally would be impacted by a level of growth that is consistent with the population and employment projections that have been prepared for Molalla by Portland State University.

TAZs were developed for the City using existing zoning and considerations of particular corridors/ intersections of concern. The 19 TAZs are shown on Figure 1 below.

Figure 1. Location of Transportation Analysis Zones (TAZs)



Data sources:

This forecast is based on the 2016 draft Economic Opportunities Analysis by Johnson Economics[1] and the 2017 Residential Buildable Land Inventory by Winterbrook Planning. GIS data for tax lots and natural resources was provided by the City of Molalla. Population forecasts are provided by Portland State University's Population Research Center (PRC).

POPULATION AND HOUSEHOLD FORECAST

Portland State University's Population Research Center (PRC) is responsible for forecasting populations for cities and counties within the State of Oregon. Their Coordinated Population Forecast for Clackamas

[1] While this is a draft document, this represents the most up-to-date information available for the City of Molalla. Available online at: http://www.cityofmolalla.com/sites/default/files/fileattachments/planning/meeting/678/molalla_goal_9_eoa_11_16_draft.pdf.

County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2017-2067 was published June 30, 2017, and is the basis for this analysis.

Figure 2 shows the historical and forecast population for communities within Clackamas County. Current-year population for the Molalla UGB is 9,939 persons. Projecting to the year 2040 with the Average Annual Growth Rate (AAGR) of 1.5% for the 2035-2067 period results in an end-year population of **15,841 persons in the year 2040.**

Figure 3 shows the persons per household for Molalla, which remained unchanged between the 2000 and 2010 census. The assumption for 2040 is that this ratio will remain the same throughout the planning horizon, at 2.8 persons per household. Dividing the population by this number results in an estimated **3,550 households in 2017, and 5,658 households in the year 2040.**

The difference between Current Year and End Year is **2,108 Households**. This is the overall growth in housing units estimated for Molalla during the planning period.

Figure 2. Clackamas County and Sub-Areas – Historical and Forecast Populations and Average Annual Growth Rates (AAGR), PRC Coordinated Population Forecast for Clackamas County, 2017

	Historical			Forecast				
	2000	2010	AAGR (2000-2010)	2017	2035	2067	AAGR (2017-2035)	AAGR (2035-2067)
Clackamas County	*338,391*	*375,992*	*1.1%*	*409,688*	*516,744*	*677,596*	*1.3%*	*0.9%*
Barlow UGB	140	137	-0.2%	140	148	161	0.3%	0.3%
Canby UGB	13,323	17,097	2.5%	17,976	24,045	35,118	1.6%	1.2%
Estacada UGB	3,067	3,330	0.8%	4,102	5,731	6,766	1.9%	0.5%
Molalla UGB	5,872	8,561	3.8%	9,939	14,705	23,678	2.2%	1.5%
Sandy UGB	5,770	9,912	5.6%	11,346	18,700	34,695	2.8%	2.0%
Outside UGBs	81,753	79,969	-0.2%	83,444	88,484	91,906	0.3%	0.1%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses; Forecast by Population Research Center (PRC).

Note: PRC does not forecast populations within the Metro area. As a result, population numbers do not add up in this table.

Figure 3. Clackamas County and Sub-Areas – Persons per Household (PPH) and Occupancy Rate, PRC Coordinated Population Forecast for Clackamas County, 2017

	Persons Per Household (PPH)			Occupancy Rate		
	2000	2010	Change 2000-2010	2000	2010	Change 2000-2010
Clackamas County	*2.6*	*2.6*	*-0.1*	*93.6%*	*92.9%*	*-0.7%*
Barlow	3.5	3.0	-0.5	97.6%	97.8%	0.3%
Canby	2.8	2.8	0.0	94.7%	95.9%	1.2%
Estacada	2.8	2.6	-0.2	96.2%	91.8%	-4.4%
Molalla	2.8	2.8	0.0	96.1%	94.5%	-1.6%
Sandy	2.7	2.7	-0.1	94.3%	94.7%	0.4%
Outside UGBs	2.8	2.7	-0.1	90.5%	88.5%	-2.0%

Sources: U.S. Census Bureau, 2000 and 2010 Censuses.

Note 1: For simplicity each UGB is referred to by its primary city's name.

RESIDENTIAL CAPACITY OF THE MOLALLA UGB

Winterbrook Planning prepared a Residential Buildable Lands Inventory (BLI) for the City of Molalla in 2017. The relevant table is shown in Figure 4. The characterization of residential land as “Multi-Family,” “Two-Family,” and “Single-Family” in this table is somewhat misleading – according to Map 2 in the BLI document these correspond to the R3, R2, and R1 districts, respectively, which each allow a combination of residential building types.

Minimum and maximum residential density is provided in the Molalla Development Code, Table 17-2.2.040.D Lot and Development Standards for Residential Zones. The minimum and maximum number of Dwelling Units (DU) per acre allowed within each zone is summarized below.

- R1: min 4 DU/Acre and max 8 DU/Acre
- R2: min 6 DU/Acre and max 12 DU/Acre
- R3: min 8 DU/Acre and max 24 DU/Acre
- R5: min 6 DU/Acre and max 24 DU/Acre

The build-out density of land with these zoning designations is described on the following pages, along with the rationale for each assumption. Estimates of the mix of housing types[2] are included in these assumptions.

[2] Housing types are broken down into Single Family Detached (SFD), Single Family Attached (SFA), and Multifamily (MF). SFA includes duplexes and triplexes. MF includes all developments with greater than four units.

Figure 4. Molalla Residential Buildable Land Inventory, Winterbrook Planning, 2017

	Lots	Acres	Buildable Acres
Vacant*			
Multi-Family	13	3.42	2.24
Single-Family	33	29.75	27.15
Two-Family	17	7.20	6.57
Total	63	40.37	35.96
Infill**			
Multi-Family	18	18.69	14.19
Single-Family	50	62.81	50.31
Two-Family	6	4.38	2.88
Total	74	85.88	67.38
Land Constrained By Wetlands***			
Multi-Family	11	2.53	
Single-Family	25	7.48	
Two-Family	1	0.06	
Total	37	10.07	
Total By Residential Districts			
Multi-Family	31	22.11	16.43
Single-Family	83	92.56	77.46
Two-Family	23	11.58	9.45
Total Buildable	137	126.25	103.34

* Lots with building value under $10,000.

** Lots greater than or equal to one-half acre and building value greater than or equal to $10,000. Buildable acres were calculated by subtracting one-quarter acre from the area of the lot.

*** Acres removed from inventory covered by wetlands and riparian zones.

R1 – Residential Low Density

- The Residential Low Density (R-1) district permits residential uses at densities between four and eight DU per net buildable acre. Permitted residential uses consist primarily of Single-Family Detached (SFD) (e.g. single-family and duplex) housing subject to special use standards."
- Analysis assumptions: Assume 8 DU/Acre at 100% SFD. This is a conservative estimate to test performance of the transportation system assuming maximum SFD development, which tends to generate more trips per unit than Single-Family Attached (SFA) or Multi-Family (MF) development. Recent developments that support this assumption include:
  - Bear Creek is a 20-acre development with 138 units, or 6.8 DU/Acre on R-1 land.

R2 – Residential Medium Density

- The Residential Medium Density (R-2) district permits residential uses at densities between six and 12 DU per net buildable acre. Permitted residential uses consist of SFD (e.g., single-family and duplex) housing and SFA (e.g., townhouse and multifamily) housing.
- Analysis assumptions: Assume 12DU/Acre at 60% SFD and 40% SFA. Recent developments that support this assumption include:

    - Single-family development along S Taylor Court which is in the 5-6 DU/AC range.

R3 – Residential Medium-High Density

- The Residential Medium-High Density (R3) district permits single-family dwellings on small lots, duplex dwellings, and multifamily dwellings at a minimum of 8 DU and a maximum of 24 DU per net buildable acre.
- Analysis Assumptions: Assume 20 DU/Acre at 25% SFA, 75% MF. Recent developments that support this assumption include:
    - Rondel Court Apartments: 30 units in 2-story walk-ups on 2.18 acres with some environmental constraints. Roughly 14 DU/Acre.
    - Stoneplace: 187 units/3 stories on 7.5 acres. Roughly 25 DU/Acre (partly on commercially-zoned land)

Multiplying these assumed densities by the remaining buildable acres listed in the BLI gives us the expected capacity of households within the remaining UGB.

Figure 5. Capacity and Unit Split of Buildable Land within the Molalla UGB

Zone	Buildable Acres (from Residential BLI)	Assumed Density (DU/Acre)	Unit Capacity	Unit Split (SFD/SFA/MF)
R-3	16.43	20	329	75% MF, 25% SFA
R-2	9.45	12	113	60% SFD, 40% SFA
R-1	77.46	8	620	100% SFD
TOTAL	**103.34**	**-**	**1,062**	

Given these (fairly aggressive) assumptions, the UGB has the capacity to accommodate roughly half of the new households expected within the planning period. For the purpose of this analysis, the first scenario will include 4,612 units (3,550 current-year households plus the capacity of 1,062 units) within the Molalla UGB. The second scenario will include the full 5,658 households within the UGB – this is not intended to be a realistic assumption about future land uses within Molalla but is a useful sensitivity analysis for assessing the impacts of the projected long-term growth in Molalla on existing transportation infrastructure.

LOCATING HOUSEHOLDS AND HOUSING TYPES

Current Year: For Current Year, households are assigned to TAZs based on block-level US Census data, which provides households per census block for the year 2010.[3] Table 1 shows the 2010 population for each TAZ and the share of the city's 2010 population within each TAZ, and applies that share to the 2017 (Current Year) population and household totals. The residential makeup of each TAZ's Comprehensive Plan designation (i.e. the proportion of R1, R2, and R3 designations) was used to estimate the current-year unit split.

Figure 6. TAZ Share of 2010 Population and 2017 Population

TAZ	2010 Population	Share of Population	2017 Population	2017 Households
1	2,492	29%	2,893	1033
2	1,014	12%	1,177	420
3	27	0%	31	11
4	7	0%	8	3
5	166	2%	193	69
6	1,153	13%	1,339	478
7	44	1%	51	18
8	921	11%	1,069	382

[3] 2010 is the most recent year for which block-level data is available. Census block boundaries do not always align with TAZ boundaries – blocks were assigned to the TAZ in which the preponderance of residential units were located, based on review of aerial imagery. One census block was apportioned evenly between TAZ 18 and TAZ 19.

TAZ	2010 Population	Share of Population	2017 Population	2017 Households
9	0	0%	0	0
10	703	8%	816	291
11	68	1%	79	28
12	0	0%	0	0
13	51	1%	59	21
14	683	8%	793	283
15	29	0%	34	12
16	13	0%	15	5
17	54	1%	63	22
18	484	6%	562	201
19	652	8%	757	270
Total	**8,561**	**100%**	**9,939**	**3,550**

Figure 7. Current-Year Household Distribution and Housing Mix

TAZ	2017 Pop	2017 HH	SFD	SFA	MF
1	2,893	1,033	889	36	108
2	1,177	420	420	0	0
3	31	11	11	0	0
4	8	3	3	0	0
5	193	69	69	0	0
6	1,339	478	197	70	211
7	51	18	0	5	14
8	1,069	382	306	51	25
9	0	0	0	0	0
10	816	291	291	0	0
11	79	28	23	1	4
12	0	0	0	0	0
13	59	21	2	5	14
14	793	283	46	82	156
15	34	12	0	3	9
16	15	5	0	1	4
17	63	22	3	6	13
18	562	201	97	75	29
19	757	270	162	108	0
TOTAL	**9,939**	**3,550**	**2,521**	**443**	**585**

Scenario 1:

Households were added to Current Year assumptions based on the amount of vacant land within each TAZ, up to the Residential Capacity of the Molalla UGB (1,062 additional units, shown below.

Figure 8. Residential Growth and 2040 Households, Scenario 1

TAZs	PopGrowth	2040 Pop	2040 HH	SFD	SFA	MF
1	506	3,399	1,214	1,044	42	127
2	374	1,551	554	554	0	0
3	25	57	20	20	0	0
4	0	8	3	3	0	0
5	944	1,137	406	406	0	0
6	139	1,478	528	218	78	233
7	0	51	18	0	5	14
8	490	1,559	557	446	74	37
9	0	0	0	0	0	0
10	48	864	309	309	0	0
11	0	79	28	23	1	4
12	0	0	0	0	0	0
13	0	59	21	2	5	14
14	198	991	354	57	103	194
15	0	34	12	0	3	9
16	0	15	5	0	1	4
17	0	63	22	3	6	13
18	191	753	269	130	100	39
19	60	817	292	175	117	0
TOTAL	**2,975**	**12,914**	**4,612**	**3,392**	**534**	**686**

Scenario 2:

Growth within each TAZ is nearly doubled from Scenario 1 in order to accommodate all forecasted housing units through 2040 (2,108 additional units).

Figure 9. Residential Growth and 2040 Households, Scenario 2

TAZ	PopGrowth	2040 Pop	2040 HH	SFD	SFA	MF
1	1,004	3,897	1,392	1,197	49	146
2	742	1,919	685	685	0	0
3	50	81	29	29	0	0
4	0	8	3	3	0	0
5	1,874	2,066	738	738	0	0
6	276	1,614	577	238	85	254

TAZ	PopGrowth	2040 Pop	2040 HH	SFD	SFA	MF
7	0	51	18	0	5	14
8	972	2,041	729	584	97	48
9	0	0	0	0	0	0
10	95	911	325	325	0	0
11	0	79	28	23	1	4
12	0	0	0	0	0	0
13	0	59	21	2	5	14
14	393	1,186	424	68	123	233
15	0	34	12	0	3	9
16	0	15	5	0	1	4
17	0	63	22	3	6	13
18	379	941	336	163	125	48
19	118	875	313	188	125	0
TOTAL	**5,902**	**15,841**	**5,658**	**4,248**	**624**	**786**

EMPLOYMENT BLI

The draft Employment Opportunities Analysis (EOA) prepared by Johnson Economics is the basis for this forecast of needed employment land within Molalla. Figure 10 shows the 20-year forecast for various employment sectors, and Figure 11 translates this growth into expected job growth is translated into six "Real Estate Typologies". EOA Figure 4.4 shows the acreage needs for these typologies. Office, Institutional, Flex/BP, and Retail typologies are assumed to occur on commercially-zoned land and General Industrial and Warehouse typologies are assumed to occur on industrially-zoned land.

Figure 10. Employment Growth Forecast (20 Year) by Industrial Sector, draft Molalla EOA, 2017

Baseline Growth Scenario	Base Year	Total Employment by Year				Change	Growth Rate
Employment Sector	2016	2021	2026	2031	2036	2016 - 2036	AAGR
Agriculture, Forestry	802	926	1,070	1,237	1,429	627	2.9%
Construction	70	83	98	117	139	70	3.5%
Manufacturing	378	416	457	503	554	175	1.9%
Wholesale Trade	98	107	118	130	143	46	1.9%
Retail Trade	493	549	611	681	759	266	2.2%
T.W.U	152	169	187	208	230	78	2.1%
Information	43	47	51	56	61	18	1.8%
Financial Activities	137	154	172	192	215	78	2.3%
Professional & Business Services	57	66	77	89	103	46	3.0%
Education & Health Services	658	743	839	948	1,070	412	2.5%
Leisure & Hospitality	400	451	509	574	647	247	2.4%
Other Services	206	229	254	282	314	108	2.1%
Government	92	100	109	118	129	37	1.7%
Total	***3,586***	***4,041***	***4,554***	***5,135***	***5,793***	***2,207***	***2.4%***

SOURCE: Oregon Employment Department, Metro Gamma Forecast, US Bureau of Economic Analysis, Johnson Economics

Figure 11. Estimated Share of Employment by Building Typology, draft Molalla EOA, 2017

Industry	Office 300 sf/emp	Institutional 600 sf/emp	Flex/BP 990 sf/emp	Gen. Ind. 600 sf/emp	Warehouse 1,850 sf/emp	Retail 500 sf/emp
	Share of Employment by Real Estate Typology					
Agriculture, Forestry	5%	0%	0%	0%	95%	0%
Construction	14%	0%	18%	40%	18%	10%
Manufacturing	8%	0%	24%	60%	8%	0%
Wholesale Trade	8%	0%	22%	20%	40%	10%
Retail	5%	1%	6%	0%	12%	76%
T.W.U.	15%	0%	12%	13%	55%	5%
Information	40%	0%	20%	30%	0%	10%
Financial Activities	72%	1%	5%	1%	1%	20%
Prof. & Business Services	72%	1%	5%	1%	1%	20%
Education & Health Services	30%	53%	2%	0%	0%	15%
Leisure & Hospitality	20%	1%	7%	1%	1%	70%
Other Services	72%	1%	5%	1%	1%	20%
Government	43%	35%	5%	1%	1%	15%
TOTAL	21%	11%	7%	9%	28%	24%

SOURCE: Metro, Johnson Economics

Figure 12. 20-Year Forecast of Employment Space and Land Need, draft Molalla EOA, 2017

Real Estate Typology	2016 Estimated Employment	2016 Est. Space Sq. Ft.	2036 Estimated Employment	2036 Est. Space Sq. Ft.	Typical Floor Area Ratio	Esimated Acreage Need 2016	Esimated Acreage Need 2036	Esimated Acreage Need 20-Year New Need
Office	758	250,200	1,204	397,400	0.35	16.4	26.1	*9.7*
Institutional	394	236,400	632	379,500	0.35	15.5	24.9	*9.4*
Flex/BP	247	269,000	380	413,300	0.35	17.6	27.1	*9.5*
Gen. Industrial	316	199,000	479	301,700	0.25	18.3	27.7	*9.4*
Warehouse	995	1,933,000	1,716	3,333,200	0.35	126.8	218.6	*91.8*
Retail	876	481,800	1,382	759,800	0.25	44.2	69.8	*25.5*
Total:	**3,586**	**3,369,400**	**5,793**	**5,584,900**		**238.9**	**394.2**	***155.3***
						Commercial Acres:		**54.0**
						Industrial Acres:		**101.3**

SOURCE: Metro, Johnson Economics

Figure 12 shows the draft EOA forecast of employment space and land need to the year 2036, but the TSP update is addressing needs through the year 2040. Figure 13 below projects ahead from the 2036 estimates assuming a continuation of the same projected growth rates.

Figure 13. Projected Employees and Employment Square Footage, 2040

Real Estate Typology	2040 Employees	2040 Est. Space Sq. Ft.	Space Growth from 2016	Estimated Acreage Need (total)	New need to 2040
Office	1,322	436,342	186,142	28.6	12.2
Institutional	692	415,809	179,409	27.3	11.8
Flex/BP	441	479,277	210,277	31.4	13.8
Gen. Industrial	567	356,853	157,853	32.8	14.5
Warehouse	1,763	3,423,802	1,490,802	224.6	97.8
Retail	1,511	830,633	348,833	76.3	32.0
TOTAL	**6,295**	**6,069,017**	**2,699,617**	**420.9**	**182.1**

As shown above, the overall acreage need for commercial land is 69.8 acres (Office, Institutional, Flex/BP, and Retail typologies) and the overall need for industrial land is 112.3 Acres (General Industrial and Warehouse typologies).

The draft EOA shows that there is a buildable supply of 34.85 acres of commercial land and 101.88 acres of industrial land within the Molalla UGB (EOA Figure 6.1). The 20-year demand for industrial land is narrowly met, but there is a shortage of land for commercial uses.

Figure 14. Reconciliation of 20-year employment Land Demand and Buildable Land Inventory, draft Molalla EOA, 2017

Employment Land Category	20-Year Demand (Acres)	Buildable Supply (Acres)	Surplus/ Shortage (Acres)
Commercial land	54.03	34.85	-19.19
Industrial land	101.27	101.88	0.61
Total:	*155.30*	*136.72*	*-18.58*

Source: Johnson Economics LLC

Looking ahead to the estimated land needs in 2040, this shortage increases to roughly 35 acres of commercial land and 10.5 acres of industrial land.

LOCATING EMPLOYMENT USES BY TAZ

Employment square footage was assigned to TAZs by determining the overall amount of employment-designated land and the amount of buildable employment land within each TAZ using GIS data from the draft EOA.

Figure 15. Employment land and Buildable Employment Land by TAZ

TAZs	Employment Acres	Share of Employment Acres	Buildable Acres	Share of Buildable Acres
1	0	0%	0	0%
2	0	0%	0	0%
3	19.2	3%	4.9	4%
4	71.5	12%	11.8	9%
5	6.3	1%	0.0	0%
6	36.4	6%	10.4	8%
7	10.7	2%	1.5	1%
8	3.2	1%	0.0	0%
9	0	0%	0	0%
10	12.3	2%	0.0	0%
11	25.9	4%	0.5	0%
12	30.0	5%	23.6	18%
13	79.9	13%	24.4	18%
14	120.2	20%	23.9	18%
15	114.9	19%	5.2	4%
16	4.8	1%	0.0	0%
17	5.0	1%	0.0	0%
18	47.5	8%	25.0	19%
19	9.0	2%	2.8	2%
TOTAL[4]	**596.8**	**100%**	**133.9**	**100%**

This square footage for employment uses is utilized by the transportation model. This square footage for current year, Scenario 1, and Scenario 2 is assigned to TAZs as follows:

Current Year:

Existing employment square footage is assigned to TAZs based on the proportion of overall employment land within each TAZ. There is a significant amount of land with employment designations and developed residential uses within the City – these have been screened out based on the assessor's property classification.

[4] Note that the total amount of buildable acres in Figure 15 below is slightly less than the supply listed in Figure 14 – this is because Figure 15 does not include a small number of parcels that are identified by the County Assessor as having existing residential uses.

Figure 16. Current Year Employment Square Footage

TAZs	Office	Institutional	Flex/BP	Gen. Industrial	Warehouse	Retail
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	8,061	7,616	8,667	6,411	62,277	15,523
4	29,967	28,314	32,219	23,835	231,522	57,707
5	2,644	2,498	2,843	2,103	20,427	5,091
6	15,270	14,428	16,418	12,146	117,977	29,406
7	4,469	4,222	4,805	3,554	34,526	8,606
8	1,360	1,285	1,462	1,082	10,507	2,619
9	0	0	0	0	0	0
10	5,143	4,860	5,530	4,091	39,736	9,904
11	10,860	10,261	11,676	8,638	83,902	20,913
12	12,555	11,863	13,499	9,986	97,001	24,178
13	33,509	31,661	36,027	26,652	258,886	64,527
14	50,390	47,611	54,177	40,079	389,306	97,034
15	48,164	45,508	51,783	38,308	372,107	92,748
16	2,016	1,905	2,167	1,603	15,573	3,882
17	2,105	1,989	2,263	1,674	16,263	4,053
18	19,926	18,827	21,424	15,849	153,947	38,371
19	3,759	3,552	4,042	2,990	29,043	7,239
TOTAL	250,200	236,400	269,000	199,000	1,933,000	481,800

Scenario 1:

Scenario 1 assumes build-out of the UGB along current trends. Vacant and partially vacant properties identified in the EOA are assumed to be built using the real estate typologies and the Floor to Area Ratios (FAR) shown in Figure 4.4. The table below assigns this growth to TAZs by parcel location and adds it to the existing development in those areas.

Figure 17. 2040 Employment Square Footage, Scenario 1

TAZs	Office	Institutional	Flex/BP	Gen. Industrial	Warehouse	Retail
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	11,991	11,362	12,984	10,250	113,835	16,836
4	39,407	37,310	42,588	33,054	355,359	60,860
5	2,644	2,498	2,843	2,103	20,427	5,091
6	23,611	22,377	25,579	20,291	227,392	32,192
7	5,706	5,401	6,163	4,762	50,749	9,019
8	1,360	1,285	1,462	1,082	10,507	2,619
9	0	0	0	0	0	0
10	5,143	4,860	5,530	4,091	39,736	9,904
11	11,261	10,643	12,116	9,029	89,163	21,047
12	31,434	29,853	34,235	28,423	344,651	30,484
13	53,015	50,249	57,452	45,701	514,760	71,043
14	69,521	65,842	75,190	58,762	640,268	103,426
15	52,294	49,444	56,320	42,342	426,289	94,127
16	2,016	1,905	2,167	1,603	15,573	3,882
17	2,105	1,989	2,263	1,674	16,263	4,053
18	39,946	37,905	43,414	35,400	416,571	45,059
19	5,975	5,663	6,475	5,154	58,109	7,979
TOTAL	**357,430**	**338,584**	**386,782**	**303,722**	**3,339,651**	**517,622**

Scenario 2:

Scenario adds all of the growth projected through 2040 to TAZs using the share of buildable acreage contained within each TAZ, presented in the table below.

Table 1.2040 Employment Square Footage, Scenario 2

TAZs	Office	Institutional	Flex/BP	Gen. Industrial	Warehouse	Retail
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	14,884	14,192	16,374	12,197	116,919	28,308
4	46,355	44,109	50,731	37,732	362,767	88,417
5	2,644	2,498	2,843	2,103	20,427	5,091
6	29,749	28,383	32,774	24,424	233,938	56,539
7	6,616	6,292	7,230	5,375	51,720	12,629
8	1,360	1,285	1,462	1,082	10,507	2,619
9	0	0	0	0	0	0
10	5,143	4,860	5,530	4,091	39,736	9,904
11	11,556	10,932	12,462	9,228	89,477	22,217
12	45,327	43,449	50,519	37,777	359,467	85,592
13	67,369	64,296	74,277	55,366	530,067	127,981
14	83,600	79,619	91,692	68,241	655,281	159,270
15	55,334	52,418	59,883	44,388	429,530	106,184
16	2,016	1,905	2,167	1,603	15,573	3,882
17	2,105	1,989	2,263	1,674	16,263	4,053
18	54,679	52,323	60,683	45,320	432,282	103,499
19	7,605	7,259	8,387	6,252	59,847	14,447
TOTAL	**436,342**	**415,809**	**479,277**	**356,853**	**3,423,802**	**830,633**

OVERALL CONCLUSIONS/OBSERVATIONS:

The primary purpose of this effort is to take previous forecasts conducted at the city-wide level and parse them out by TAZ to create an updated set of population and employment projections which will be the basis of traffic projections for the TSP. These updated projections are more spatially accurate than the initial projections that were prepared and reflected the estimated capacity for future growth within the existing UGB. They also provide a sensitivity analysis for considering potential impacts of all growth assumed by the future coordinated PSU population and employment projections. This information will be used in assessing transportation impacts of growth within the City and identifying ways of mitigating these impacts in order to create an effective plan for the future.

In addition, we can make the following broad conclusions and observations.

1. Given the (fairly aggressive) assumptions of this forecast, residential land within the UGB has the capacity to accommodate roughly half of the new households expected within the planning period. However, this forecast does not address any “efficiency measures” or strategies to use land within the City of Molalla more efficiently, such as re-zoning land or changing development requirements. An analysis of efficiency measures would be required if the City were to embark on a UGB amendment process.
2. The draft EOA shows that the demand for industrial land through 2036 (the EOA’s planning horizon) is narrowly met and there is a shortage of land for commercial uses. Looking ahead to the estimated land needs in 2040 for this TSP update, this shortage increases to roughly 35 acres of commercial land and 10.5 acres of industrial land for that year, assuming no change in the rate of Molalla’s employment growth.
3. Schools and other institutional uses do not fit neatly into these categories of residential/employment land – they are often located on residentially-zoned land and therefore were not included in the inventory of employment land. Schools in Molalla, particularly Molalla High School in TAZ 9, will need to be addressed discretely within the transportation model.

Attachment C Detailed PLTS Analysis Results

Table C-1: Detailed PLTS Analysis Results

Street	From	To	Side	Pedestrian LTS Criteria									
				Speed (MPH)	Total Number of Lanes	Bike Lane Width (feet)	Parking	Sidewalk Condition	Sidewalk Width (feet) [1]	Buffer	Illumination	Land Use	PLTS
Major Arterial													
OR 213	City Limits (north)	Meadow Drive	East	45	2	N/A	No	Fair	=> 5	Solid Surface	No	Residential	2
	Meadow Drive	S Molalla Road	East	45	3	N/A	No	Fair	=> 5	Solid Surface	No	Residential	2
	S Molalla Road	Toliver Road	N/A	45	2	N/A	No	N/A	N/A	N/A	No	Residential	4
	Toliver Road	31275 OR 213	N/A	45	2	N/A	No	N/A	N/A	N/A	No	Residential	4
	31275 OR 213	31288 OR 213	West	40	3	< 5.5	No	Good	=> 6	Curb Tight	No	Auto-oriented commercial	4
	31290 OR 213	OR 211	East	40	3	< 5.5	No	Good	=> 6	Curb Tight	No	Low density development	4
	OR 211	31600 OR 213	East	40	4	< 5.5	No	Fair	4 – 5	Curb Tight	No	Low density development	4
	31600 OR 213	City Limits (south)	31600 OR 213	40	2	N/A	No	N/A	N/A	N/A	No	Residential	4
OR 211	City Limits (east)	OR 213	N/A	35	N/A	< 5.5	No	N/A	N/A	N/A	Yes	Residential	4
	OR 213	12700 OR 211	Both	35	4	< 5.5	No	Fair	=> 6	Curb Tight	Yes	Auto-oriented commercial	4
	12700 OR 211	1524 W Main Street	North	35	3	< 5.5	No	Good	=> 6	Curb Tight	No	Low density development	3
	1524 W Main Street	1400 Fountain Way	N/A	35	3	N/A	No	N/A	N/A	N/A	No	Low density development	4
	1400 Fountain Way	Industrial Way	North	35	3	N/A	No	Good	=> 6	Landscape w/ Trees	No	Low density development	2
	Industrial Way	12966 OR 211	N/A	35	2	N/A	No	N/A	N/A	N/A	No	Residential	4
	12966 OR 211	Molalla Forest Road	South	35	2	N/A	No	Fair	=> 6	Curb Tight	No	Residential	3
	Molalla Forest Road	872 W Main Street	N/A	35	2	N/A	No	N/A	N/A	N/A	No	Residential	4

	872 W Main Street	N Hezzie Lane	South	35	3	N/A	No	Good	=> 6	Landscape w/ Trees	No	Residential	1
	N Hezzie Lane	805 W Main Street	North	35	3	N/A	No	Good	4 – 5	Curb Tight	No	Residential	3
	805 W Main Street	Leroy Avenue	N/A	35	2	N/A	No	N/A	N/A	N/A	No	Low density development	4
	Leroy Avenue	701 W Main Street	North	35	2	N/A	No	Very Poor	4 – 5	Landscape	No	Residential	4
	701 W Main Street	631 W Main Street	Both	35	2	N/A	No	Poor	4 – 5	Curb Tight	No	Residential	3
	631 W Main Street	Thelander Lane	South	35	3	N/A	No	Fair	=> 6	Curb Tight	Yes	Low density development	3
	Thelander Lane	304 W Main Street	N/A	35	2	N/A	No	N/A	N/A	N/A	Yes	Low density development	4
	304 W Main Street	Metzler Street	Both	25	3	N/A	Yes	Poor	4 – 5	Curb Tight	Yes	Low density development	3
	Metzler Street	Molalla Avenue	Both	25	3	N/A	Yes	Fair	=> 5	Curb Tight	Yes	Low density development	2
	Molalla Avenue	Lola Street	Both	25	2	N/A	Yes	Fair	=> 5	Curb Tight	Yes	Low density development	2
	Lola Street	N Cole Avenue	Both	30	2	N/A	Yes	Fair	=> 5	Landscape w/ Trees	Yes	Residential	2
	N Cole Avenue	810 E Main Street	Both	30	2	N/A	Yes	Fair	=> 5	Landscape w/ Trees	No	Residential	2
	810 E Main Street	City Limits (east)	N/A	30	N/A	N/A	No	N/A	N/A	N/A	No	Residential	4
Molalla Avenue	City Limits (north)	Church Street	N/A	35	N/A	N/A	No	N/A	N/A	N/A	No	Residential	4
	Church Street	Thunderbird Street	West	35	2	N/A	No	Fair	=> 5	Curb Tight	No	Residential	3
	Thunderbird Street	Miller Street	East	25	2	N/A	No	Poor	4 – 5	Landscape	No	Residential	3
	Miller Street	E Francis Street	Both	25	2	N/A	No	Poor	4 – 5	Landscape	No	Residential	3
	E Francis Street	Toliver Road	Both	25	2	N/A	No	Poor	4 – 5	Landscape	Yes	Residential	3
	Toliver Road	527 Molalla Avenue	Both	25	2	N/A	No	Poor	4 – 5	Landscape w/ Trees	Yes	Residential	3
	527 Molalla Avenue	E Heintz Street	West	25	2	N/A	No	Poor	=> 5	Landscape	Yes	Low density development	3

	E Heintz Street	OR 211	Both	25	2	N/A	Yes	Good	=> 6	Curb Tight	Yes	Low density development	2
	OR 211	E 2nd Street	Both	25	2	N/A	Yes	Good	=> 6	Curb Tight	Yes	Low density development	2
	E 2nd Street	E 3rd Street	Both	25	2	N/A	Yes	Good	=> 6	Curb Tight	Yes	Residential	1
	E 3rd Street	E 6th Street	Both	25	2	N/A	Yes	Fair	=> 5	Landscape	Yes	Residential	2
	E 6th Street	614 Molalla Avenue	Both	25	2	N/A	Yes	Poor	4 – 5	Landscape	Yes	Residential	3
	614 Molalla Avenue	City Limits (south)	N/A	25	2	N/A	Yes	N/A	N/A	N/A	No	Residential	4
Major Collectors													
Meadow Drive	OR 213	Harvest Lane	Both	25	2	N/A	Yes	Fair	=> 5	Curb Tight	Yes	Residential	2
	Harvest Lane	Cascade Lane	Both	25	2	N/A	Yes	Fair	4 – 5[2]	Curb Tight	Yes	Residential	3
	Cascade Lane	Harvey Lane	Both	25	2	N/A	Yes	Fair	4 – 5[2]	Curb Tight	Yes	Residential	3
	Harvey Lane	Meadowlawn Place	Both	25	2	N/A	Yes	Good	=> 5	Curb Tight	Yes	Residential	2
	Meadowlawn Place	Toliver Road	Both	25	2	N/A	Yes	Fair	4 – 5[2]	Curb Tight	No	Residential	3
Toliver Road	City Limits (west)	1700 Toliver Road	North	45	N/A	N/A	No	N/A	N/A	N/A	No	Residential	4
	City Limits (west)	1700 Toliver Road	South	45	2	N/A	No	Good	=> 5	Curb Tight	Yes	Residential	4
	1700 Toliver Road	OR 213	South	45	2	N/A	N/A	N/A	N/A	N/A	No	Residential	4
	OR 213	Industrial Way	South	35	2	Yes	No	Good	=> 6[3]	Landscape	Yes	Residential	1
	Industrial Way	Molalla Forest Road	South	35	2	Yes	No	Good	=> 6[3]	Landscape	Yes	Residential	1
	Molalla Forest Road	1015 Toliver Road	Both	35	2	Yes	No	Good	=> 6[3]	Landscape	Yes	Residential	1
	1015 Toliver Road	Zimmerman Lane	South	35	2	Yes	No	Good	=> 6[3]	Landscape	Yes	Residential	1
	Zimmerman Lane	905 Toliver Road	South	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	905 Toliver Road	Kalugin Court	Both	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Kalugin Court	Village Drive	South	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Village Drive	800 Trinity Court	Both	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2

	800 Trinity Court	Ridings Avenue	South	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Ridings Avenue	Zephyr Way	Both	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Zephyr Way	Pegasus Court	South	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Pegasus Court	31 Toliver Road	Both	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	31 Toliver Road	Molalla Avenue	South	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
Shirley Street	Molalla Avenue	101 Shirley Street	Both	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	101 Shirley Street	Fenton Street	South	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	Fenton Street	N Cole Avenue	South	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	N Cole	321 E Park Avenue	South	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	321 E Park Avenue	300 Steelhead Street	South	25	2	No	Yes	Fair	=> 6[3]	Landscape w/ Trees	No	Residential	1
	300 Steelhead Street	301 Steelhead Street	Both	25	2	No	Yes	Fair	=> 6[3]	Landscape	No	Residential	1
	301 Steelhead Street	OR 211	South	25	2	No	No	N/A	N/A	N/A	No	Residential	4
Leroy Avenue	Toliver Road	Lynn Lane	West	20	2	No	No	Good	=> 6	Curb Tight	No	Residential	2
	Lynn Lane	Skye Lane	West	20	2	No	No	Good	=> 5	Landscape	No	Residential	1
	Skye Lane	209 Leroy Avenue	West	20	2	No	No	Good	=> 6	Curb Tight	No	Residential	2
	209 Leroy Avenue	OR 211	Both	20	2	No	No	Good	=> 5	Curb Tight	No	Residential	2
	Toliver Road	209 Leroy Avenue	East	20	2	No	No	N/A	N/A	N/A	No	Residential	4
E 5th Street	Molalla Avenue	Berkley Avenue	North	25	2	Yes	No	Good	=> 5	Landscape	Yes	Residential	1
	Molalla Avenue	May Street	South	25	2	Yes	Yes	Good	=> 5	Landscape	No	Residential	2
	May Street	Berkley Avenue	South	25	2	Yes	Yes	Good	=> 5	Curb Tight	No	Residential	2
	Berkley Avenue	Stower Road	Both	25	2	Yes	No	Fair	=> 5	Curb Tight	No	Residential	2
	Stower Road	S Mathias Road	N/A	25	2	N/A	Yes	N/A	N/A	N/A	No	Residential	4

Minor Collectors													
Frances Street	Molalla Avenue	Debra Street	North	25	2	No	No	Fair	=> 5	Curb Tight	No	Residential	2
	Debra Street	N Cole Avenue	Both	25	2	No	No	Fair	=> 5	Curb Tight	No	Residential	2
Ridings Avenue	Toliver Road	Heintz Street	Both	25	2	N/A	Yes	N/A	N/A	N/A	No	Residential	4
	Heintz Street	Prince Court	East	25	2	N/A	Yes	Good	=> 5	Curb Tight	No	Residential	2
	Heintz Street	Prince Court	West	25	2	N/A	Yes	N/A	N/A	N/A	No	Residential	4
	Prince Court	OR 211	Both	25	2	N/A	Yes	N/A	N/A	N/A	No	Residential	4
N Cole Avenue	Frances Street	Shirley Street	West	25	2	No	No	Poor	4 – 5	Curb Tight	No	Residential	3
	Shirley Street	Heintz Street	Both	25	2	No	No	Poor	4 – 5	Landscape w/ Trees	No	Residential	3
	Heintz Street	207 N Cole Street	Both	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	207 N Cole Avenue	Patrol Street	West	25	2	No	Yes	Good	=> 5	Curb Tight	No	Residential	2
	Patrol Street	151 N Cole Avenue	West	25	2	No	Yes	Fair	=> 5	Curb Tight	No	Residential	2
	151 N Cole Avenue	127 N Cole Avenue	Both	25	2	No	Yes	Poor	4 – 5	Curb Tight	No	Residential	3
	127 N Cole Avenue	OR 211	West	25	2	No	Yes	Very Poor	4 – 5	Curb Tight	No	Residential	4

[1] Sidewalk refers to sidewalks, shared-use paths, and pedestrian paths.
[2] Obstructed segments of sidewalk due to mailbox(s)
[3] Shared-use Path

Attachment D Trip Generation Tables

TRIP GENERATION ESTIMATES

Trip generation estimates were prepared for the TSP update based on information provided in the standard reference manual, *Trip Generation*, *9th Edition*, published by the Institute of Transportation Engineers (ITE). Tables D-1 and D-2 summarize the total trips by Transportation Analysis Zone (TAZ) for Scenario 1 and Scenario 2 respectively.

Table D-1: Trip Generation Estimate, Weekday PM Peak Hour (Scenario 1)

	Housing			Employment			Total		
TAZ	Total	In	Out	Total	In	Out	Total	In	Out
1	170	107	63				170	107	63
2	134	84	50				134	84	50
3	9	6	3	35	8	26	44	14	30
4				83	20	63	83	20	63
5	337	212	125				337	212	125
6	39	25	14	74	18	56	113	43	70
7				11	3	8	11	3	8
8	159	101	58				159	101	58
9									
10	18	11	7				18	11	7
11				4	1	3	4	1	3
12				167	41	126	167	41	126
13				172	42	130	172	42	130
14	45	30	16	169	41	128	215	71	144
15				36	9	28	36	9	28
16									
17									
18	52	34	19	177	43	134	229	77	152
19	18	11	6	20	5	15	37	16	21

Table D-2: Trip Generation Estimate, Weekday PM Peak Hour (Scenario 1)

	Housing			Employment			Total		
TAZ	In	Out	Total	In	Out	Total	In	Out	Total
1	338	214	124				338	214	124
2	265	167	98				265	167	98
3	18	11	7	74	24	50	92	35	57
4				178	58	121	178	58	121
5	669	421	248				669	421	248
6	75	48	27	158	51	107	233	99	134
7				23	8	16	23	8	16
8	316	200	116				316	200	116
9									
10	34	21	13				34	21	13
11				8	2	5	8	2	5
12				357	115	242	357	115	242

13				369	119	250	369	119	250
14	91	59	32	362	117	245	453	176	277
15				78	25	53	78	25	53
16									
17									
18	104	67	37	378	122	256	482	189	293
19	35	22	13	42	14	28	77	36	41

Attachment E Year 2040 Traffic Conditions Worksheets (Scenario 1)

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	15	0	17	0	531	23	48	980	0
Future Vol, veh/h	0	0	0	15	0	17	0	531	23	48	980	0
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	1	1	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	0	0	0	13	0	6	0	9	4	4	7	0
Mvmt Flow	0	0	0	16	0	18	0	565	24	51	1043	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1732	1736	1044	1723	1724	578	1044	0	0	590	0	0
Stage 1	1146	1146	-	578	578	-	-	-	-	-	-	-
Stage 2	586	590	-	1145	1146	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.23	6.5	6.26	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.23	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.23	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.617	4	3.354	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	70	88	281	66	90	508	674	-	-	976	-	-
Stage 1	245	276	-	483	504	-	-	-	-	-	-	-
Stage 2	500	498	-	231	276	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	61	77	281	60	79	508	674	-	-	976	-	-
Mov Cap-2 Maneuver	61	77	-	60	79	-	-	-	-	-	-	-
Stage 1	245	242	-	483	504	-	-	-	-	-	-	-
Stage 2	482	498	-	202	242	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	50	0	0.4
HCM LOS	A	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	674	-	-	-	113	976	-	-
HCM Lane V/C Ratio	-	-	-	-	0.301	0.052	-	-
HCM Control Delay (s)	0	-	-	0	50	8.9	0	-
HCM Lane LOS	A	-	-	A	F	A	A	-
HCM 95th %tile Q(veh)	0	-	-	-	1.2	0.2	-	-

Intersection	
Int Delay, s/veh	6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	45	55	504	84	162	826
Future Vol, veh/h	45	55	504	84	162	826
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	100	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	4	8	9	5	1	9
Mvmt Flow	48	59	542	90	174	888

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1780	543	0	0	543	0
Stage 1	543	-	-	-	-	-
Stage 2	1237	-	-	-	-	-
Critical Hdwy	6.44	6.28	-	-	4.11	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.372	-	-	2.209	-
Pot Cap-1 Maneuver	89	528	-	-	1031	-
Stage 1	578	-	-	-	-	-
Stage 2	271	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	74	527	-	-	1031	-
Mov Cap-2 Maneuver	74	-	-	-	-	-
Stage 1	577	-	-	-	-	-
Stage 2	225	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	86.3	0	1.5
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	140	1031	-
HCM Lane V/C Ratio	-	-	0.768	0.169	-
HCM Control Delay (s)	-	-	86.3	9.2	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	4.6	0.6	-

Intersection	
Int Delay, s/veh	5499.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	7	34	68	108	19	72	27	505	175	178	681	8
Future Vol, veh/h	7	34	68	108	19	72	27	505	175	178	681	8
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	4	2	2	0	2	4	9	20	11	8	0
Mvmt Flow	8	37	74	117	21	78	29	549	190	193	740	9

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1885	1931	747	1891	1840	644	750	0	0	739	0	0
Stage 1	1133	1133	-	703	703	-	-	-	-	-	-	-
Stage 2	752	798	-	1188	1137	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.54	6.22	7.12	6.5	6.22	4.14	-	-	4.21	-	-
Critical Hdwy Stg 1	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.036	3.318	3.518	4	3.318	2.236	-	-	2.299	-	-
Pot Cap-1 Maneuver	55	65	413	~ 53	76	473	850	-	-	828	-	-
Stage 1	249	276	-	428	443	-	-	-	-	-	-	-
Stage 2	405	395	-	230	279	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	20	37	412	~ 1	43	473	849	-	-	828	-	-
Mov Cap-2 Maneuver	20	37	-	~ 1	43	-	-	-	-	-	-	-
Stage 1	234	165	-	402	416	-	-	-	-	-	-	-
Stage 2	302	371	-	~ 88	167	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 399.6	$ 51776.5	0.4	2.2
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	849	-	-	76	2	828	-	-
HCM Lane V/C Ratio	0.035	-	-	1.559	108.152	0.234	-	-
HCM Control Delay (s)	9.4	0	-	$ 399.6	$ 51776.5	10.7	0	-
HCM Lane LOS	A	A	-	F	F	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	9.8	29.5	0.9	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	217	556	237	355	190	49	248	176	321	566
v/c Ratio	1.25	0.91	1.29	0.58	0.29	0.49	0.46	0.31	1.72	0.94
Control Delay	198.4	64.0	212.0	42.9	5.7	82.0	43.3	6.3	377.9	67.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	198.4	64.0	212.0	42.9	5.7	82.0	43.3	6.3	377.9	67.7
Queue Length 50th (ft)	~263	495	~293	273	0	46	188	0	~455	510
Queue Length 95th (ft)	#449	#748	#486	396	55	91	272	55	#673	#787
Internal Link Dist (ft)		1906		2602			1480			1933
Turn Bay Length (ft)	275		230		230	250		250	200	
Base Capacity (vph)	174	655	184	653	681	163	672	660	187	629
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.25	0.85	1.29	0.54	0.28	0.30	0.37	0.27	1.72	0.90

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	468	43	218	327	175	45	228	162	295	363	157
Future Volume (vph)	200	468	43	218	327	175	45	228	162	295	363	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1597	1794		1687	1776	1524	1492	1845	1504	1719	1698	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1597	1794		1687	1776	1524	1492	1845	1504	1719	1698	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	217	509	47	237	355	190	49	248	176	321	395	171
RTOR Reduction (vph)	0	2	0	0	0	125	0	0	124	0	10	0
Lane Group Flow (vph)	217	554	0	237	355	65	49	248	52	321	556	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	13%	5%	0%	7%	7%	6%	21%	3%	5%	5%	5%	11%
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases						4			6			
Actuated Green, G (s)	15.2	47.4		15.2	47.9	47.9	8.0	41.5	41.5	15.2	48.7	
Effective Green, g (s)	15.2	47.4		15.2	47.9	47.9	8.0	41.5	41.5	15.2	48.7	
Actuated g/C Ratio	0.11	0.34		0.11	0.34	0.34	0.06	0.30	0.30	0.11	0.35	
Clearance Time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	
Vehicle Extension (s)	2.3	5.0		2.3	5.0	5.0	2.3	2.0	2.0	2.3	2.0	
Lane Grp Cap (vph)	173	607		183	608	521	85	547	446	186	591	
v/s Ratio Prot	0.14	c0.31		c0.14	0.20		0.03	0.13		c0.19	c0.33	
v/s Ratio Perm						0.04			0.03			
v/c Ratio	1.25	0.91		1.30	0.58	0.12	0.58	0.45	0.12	1.73	0.94	
Uniform Delay, d1	62.4	44.3		62.4	37.8	31.6	64.3	40.0	35.9	62.4	44.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	152.9	19.0		167.1	2.2	0.2	6.8	0.2	0.0	348.2	23.2	
Delay (s)	215.2	63.3		229.4	40.0	31.8	71.1	40.2	35.9	410.5	67.4	
Level of Service	F	E		F	D	C	E	D	D	F	E	
Approach Delay (s)		105.9			95.4			41.8			191.6	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	118.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	139.9	Sum of lost time (s)	20.6
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Intersection						
Int Delay, s/veh	74.2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1043	81	49	850	93	82
Future Vol, veh/h	1043	81	49	850	93	82
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	6	0	0
Mvmt Flow	1122	87	53	914	100	88

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1209	0	2184	1165
Stage 1	-	-	-	-	1165	-
Stage 2	-	-	-	-	1019	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	584	-	~ 51	239
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	351	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	584	-	~ 42	239
Mov Cap-2 Maneuver	-	-	-	-	~ 42	-
Stage 1	-	-	-	-	299	-
Stage 2	-	-	-	-	286	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	$ 928.9
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	68	-	-	584	-
HCM Lane V/C Ratio	2.767	-	-	0.09	-
HCM Control Delay (s)	$ 928.9	-	-	11.8	0
HCM Lane LOS	F	-	-	B	A
HCM 95th %tile Q(veh)	18.8	-	-	0.3	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	63.7					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	141	955	780	83	52	116
Future Vol, veh/h	141	955	780	83	52	116
Conflicting Peds, #/hr	3	0	0	3	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	4	5	6	4	0	2
Mvmt Flow	150	1016	830	88	55	123

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	921	0	-	0	2193	877
Stage 1	-	-	-	-	877	-
Stage 2	-	-	-	-	1316	-
Critical Hdwy	4.14	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.236	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	733	-	-	-	~ 50	348
Stage 1	-	-	-	-	410	-
Stage 2	-	-	-	-	253	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	733	-	-	-	~ 26	347
Mov Cap-2 Maneuver	-	-	-	-	~ 26	-
Stage 1	-	-	-	-	409	-
Stage 2	-	-	-	-	134	-

Approach	EB	WB	SB
HCM Control Delay, s	1.4	0	$ 797.3
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	733	-	-	-	72
HCM Lane V/C Ratio	0.205	-	-	-	2.482
HCM Control Delay (s)	11.2	0	-	-	$ 797.3
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0.8	-	-	-	17.2

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	7.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	76	930	786	40	33	74
Future Vol, veh/h	76	930	786	40	33	74
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	5	5	9	14	2
Mvmt Flow	79	969	819	42	34	77

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	860	0	-	0	1967	840
Stage 1	-	-	-	-	840	-
Stage 2	-	-	-	-	1127	-
Critical Hdwy	4.1	-	-	-	6.54	6.22
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	2.2	-	-	-	3.626	3.318
Pot Cap-1 Maneuver	790	-	-	-	64	365
Stage 1	-	-	-	-	404	-
Stage 2	-	-	-	-	293	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	790	-	-	-	50	365
Mov Cap-2 Maneuver	-	-	-	-	50	-
Stage 1	-	-	-	-	404	-
Stage 2	-	-	-	-	229	-

Approach	EB	WB	SB
HCM Control Delay, s	0.8	0	122
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	790	-	-	-	124
HCM Lane V/C Ratio	0.1	-	-	-	0.899
HCM Control Delay (s)	10.1	0	-	-	122
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0.3	-	-	-	5.7

Intersection	
Intersection Delay, s/veh	225.7
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	105	528	167	19	438	64	190	140	28	89	144	149
Future Vol, veh/h	105	528	167	19	438	64	190	140	28	89	144	149
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles, %	5	6	4	7	7	2	11	10	0	5	5	1
Mvmt Flow	109	550	174	20	456	67	198	146	29	93	150	155
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	321.6	256.7	96.8	103.3
HCM LOS	F	F	F	F

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	53%	17%	0%	4%	23%
Vol Thru, %	39%	83%	0%	84%	38%
Vol Right, %	8%	0%	100%	12%	39%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	358	633	167	521	382
LT Vol	190	105	0	19	89
Through Vol	140	528	0	438	144
RT Vol	28	0	167	64	149
Lane Flow Rate	373	659	174	543	398
Geometry Grp	2	7	7	5	2
Degree of Util (X)	1.019	1.807	0.44	1.469	1.049
Departure Headway (Hd)	12.795	11.288	10.481	11.429	12.299
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	287	330	346	326	298
Service Time	10.795	8.988	8.181	9.429	10.299
HCM Lane V/C Ratio	1.3	1.997	0.503	1.666	1.336
HCM Control Delay	96.8	400.9	21.2	256.7	103.3
HCM Lane LOS	F	F	C	F	F
HCM 95th-tile Q	10.7	37.9	2.2	25.3	11.7

Intersection	
Int Delay, s/veh	7.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	73	338	105	0	311	9	111	7	0	2	9	46
Future Vol, veh/h	73	338	105	0	311	9	111	7	0	2	9	46
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	1	1	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	3	9	8	1	4	0	14	14	0	0	11	4
Mvmt Flow	79	367	114	0	338	10	121	8	0	2	10	50

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	350	0	0	-	-	0	956	933	-	933	985	345
Stage 1	-	-	-	-	-	-	583	583	-	345	345	-
Stage 2	-	-	-	-	-	-	373	350	-	588	640	-
Critical Hdwy	4.13	-	-	-	-	-	7.24	6.64	-	7.1	6.61	6.24
Critical Hdwy Stg 1	-	-	-	-	-	-	6.24	5.64	-	6.1	5.61	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.24	5.64	-	6.1	5.61	-
Follow-up Hdwy	2.227	-	-	-	-	-	3.626	4.126	-	3.5	4.099	3.336
Pot Cap-1 Maneuver	1203	-	-	0	-	-	226	254	0	248	239	693
Stage 1	-	-	-	0	-	-	478	480	0	675	620	-
Stage 2	-	-	-	0	-	-	624	612	0	499	456	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1203	-	-	-	-	-	188	230	-	224	217	692
Mov Cap-2 Maneuver	-	-	-	-	-	-	188	230	-	224	217	-
Stage 1	-	-	-	-	-	-	435	436	-	612	619	-
Stage 2	-	-	-	-	-	-	570	611	-	445	415	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.2	0	56.2	13.4
HCM LOS			F	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBT	WBR	SBLn1
Capacity (veh/h)	190	1203	-	-	-	-	488
HCM Lane V/C Ratio	0.675	0.066	-	-	-	-	0.127
HCM Control Delay (s)	56.2	8.2	0	-	-	-	13.4
HCM Lane LOS	F	A	A	-	-	-	B
HCM 95th %tile Q(veh)	4.1	0.2	-	-	-	-	0.4

Intersection						
Int Delay, s/veh	1.4					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	44	19	21	405	376	73
Future Vol, veh/h	44	19	21	405	376	73
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	9	0	7	6	5	4
Mvmt Flow	46	20	22	426	396	77

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	905	434	473	0	-	0
Stage 1	434	-	-	-	-	-
Stage 2	471	-	-	-	-	-
Critical Hdwy	6.49	6.2	4.17	-	-	-
Critical Hdwy Stg 1	5.49	-	-	-	-	-
Critical Hdwy Stg 2	5.49	-	-	-	-	-
Follow-up Hdwy	3.581	3.3	2.263	-	-	-
Pot Cap-1 Maneuver	298	626	1063	-	-	-
Stage 1	639	-	-	-	-	-
Stage 2	614	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	290	626	1063	-	-	-
Mov Cap-2 Maneuver	290	-	-	-	-	-
Stage 1	639	-	-	-	-	-
Stage 2	597	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	17.9	0.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1063	-	346	-	-
HCM Lane V/C Ratio	0.021	-	0.192	-	-
HCM Control Delay (s)	8.5	0	17.9	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.7	-	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	21	53	18	193	315	7
Future Vol, veh/h	21	53	18	193	315	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	6	5	3	0
Mvmt Flow	24	60	20	217	354	8

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	615	358	362	0	-	0
Stage 1	358	-	-	-	-	-
Stage 2	257	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.16	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.254	-	-	-
Pot Cap-1 Maneuver	458	691	1175	-	-	-
Stage 1	712	-	-	-	-	-
Stage 2	791	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	449	691	1175	-	-	-
Mov Cap-2 Maneuver	449	-	-	-	-	-
Stage 1	712	-	-	-	-	-
Stage 2	776	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1175	-	599	-	-
HCM Lane V/C Ratio	0.017	-	0.139	-	-
HCM Control Delay (s)	8.1	0	12	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.5	-	-

Intersection	
Int Delay, s/veh	7.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	67	193	185	203	298	75
Future Vol, veh/h	67	193	185	203	298	75
Conflicting Peds, #/hr	0	3	3	0	0	3
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	25	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	1	4	2	3	3
Mvmt Flow	70	201	193	211	310	78

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	949	355	392	0	-	0
Stage 1	352	-	-	-	-	-
Stage 2	597	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.14	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.236	-	-	-
Pot Cap-1 Maneuver	291	691	1156	-	-	-
Stage 1	716	-	-	-	-	-
Stage 2	554	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	241	687	1153	-	-	-
Mov Cap-2 Maneuver	241	-	-	-	-	-
Stage 1	714	-	-	-	-	-
Stage 2	460	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23	4.2	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1153	-	465	-	-
HCM Lane V/C Ratio	0.167	-	0.582	-	-
HCM Control Delay (s)	8.7	-	23	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.6	-	3.6	-	-

Intersection						
Int Delay, s/veh	3.6					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	59	79	308	64	108	391
Future Vol, veh/h	59	79	308	64	108	391
Conflicting Peds, #/hr	0	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	10	5	4	0	5	2
Mvmt Flow	60	81	314	65	110	399

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	970	351	0	0	384	0
Stage 1	351	-	-	-	-	-
Stage 2	619	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.15	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.245	-
Pot Cap-1 Maneuver	272	686	-	-	1158	-
Stage 1	695	-	-	-	-	-
Stage 2	522	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	245	683	-	-	1158	-
Mov Cap-2 Maneuver	245	-	-	-	-	-
Stage 1	692	-	-	-	-	-
Stage 2	472	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.5	0	1.8
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	387	1158	-
HCM Lane V/C Ratio	-	-	0.364	0.095	-
HCM Control Delay (s)	-	-	19.5	8.4	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	1.6	0.3	-

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	7	29	22	19	23	79	17	292	14	99	335	23
Future Vol, veh/h	7	29	22	19	23	79	17	292	14	99	335	23
Conflicting Peds, #/hr	3	0	6	6	0	3	4	0	5	5	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	7	0	0	3	17	3	0	0	2	0
Mvmt Flow	7	30	23	20	24	82	18	304	15	103	349	24

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	974	930	371	952	935	319	377	0	0	324	0	0
Stage 1	571	571	-	352	352	-	-	-	-	-	-	-
Stage 2	403	359	-	600	583	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.27	7.1	6.5	6.23	4.27	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.363	3.5	4	3.327	2.353	-	-	2.2	-	-
Pot Cap-1 Maneuver	233	269	664	241	267	719	1104	-	-	1247	-	-
Stage 1	509	508	-	669	635	-	-	-	-	-	-	-
Stage 2	628	631	-	491	502	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	171	234	658	188	232	714	1098	-	-	1243	-	-
Mov Cap-2 Maneuver	171	234	-	188	232	-	-	-	-	-	-	-
Stage 1	497	453	-	652	619	-	-	-	-	-	-	-
Stage 2	522	615	-	394	448	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	20.5	18.6	0.4	1.8
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1098	-	-	292	389	1243	-	-
HCM Lane V/C Ratio	0.016	-	-	0.207	0.324	0.083	-	-
HCM Control Delay (s)	8.3	0	-	20.5	18.6	8.2	0	-
HCM Lane LOS	A	A	-	C	C	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.8	1.4	0.3	-	-

Intersection	
Int Delay, s/veh	8.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	53	48	6	19	29	136	1	113	22	121	160	46
Future Vol, veh/h	53	48	6	19	29	136	1	113	22	121	160	46
Conflicting Peds, #/hr	5	0	0	0	0	5	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	3	33	6	0	0	0	4	5	4	2	0
Mvmt Flow	59	53	7	21	32	151	1	126	24	134	178	51

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	709	626	203	644	640	145	229	0	0	152	0	0
Stage 1	472	472	-	142	142	-	-	-	-	-	-	-
Stage 2	237	154	-	502	498	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.53	7.16	6.5	6.2	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.597	3.554	4	3.3	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	352	399	765	380	396	908	1351	-	-	1417	-	-
Stage 1	576	557	-	851	783	-	-	-	-	-	-	-
Stage 2	771	768	-	544	548	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	248	354	765	305	351	902	1351	-	-	1410	-	-
Mov Cap-2 Maneuver	248	354	-	305	351	-	-	-	-	-	-	-
Stage 1	575	496	-	849	781	-	-	-	-	-	-	-
Stage 2	612	766	-	428	488	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24.7	13.6	0.1	2.9
HCM LOS	C	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1351	-	-	300	622	1410	-	-
HCM Lane V/C Ratio	0.001	-	-	0.396	0.329	0.095	-	-
HCM Control Delay (s)	7.7	0	-	24.7	13.6	7.8	-	-
HCM Lane LOS	A	A	-	C	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	1.8	1.4	0.3	-	-

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	33	22	13	134	157	38
Future Vol, veh/h	33	22	13	134	157	38
Conflicting Peds, #/hr	0	4	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	5	0	6	3	0
Mvmt Flow	40	27	16	163	191	46

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	414	223	242	0	-	0
Stage 1	219	-	-	-	-	-
Stage 2	195	-	-	-	-	-
Critical Hdwy	6.4	6.25	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	2.2	-	-	-
Pot Cap-1 Maneuver	599	809	1336	-	-	-
Stage 1	822	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	587	803	1331	-	-	-
Mov Cap-2 Maneuver	587	-	-	-	-	-
Stage 1	819	-	-	-	-	-
Stage 2	829	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.1	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1331	-	658	-	-
HCM Lane V/C Ratio	0.012	-	0.102	-	-
HCM Control Delay (s)	7.7	0	11.1	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Attachment F Signal Warrant Worksheets

KITTELSON & ASSOCIATES, INC.
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(503) 228-5230
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_213_Toliver_TTPM.xls]Data Input
Intersection:	OR 213/Toliver Road
Scenario:	2040 Future Traffic Conditions (Scen 1)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	532	859	41	127
2nd	Highest Hour	509	822	39	122
3rd	Highest Hour	486	785	37	116
4th	Highest Hour	464	749	36	111
5th	Highest Hour	441	712	34	105
6th	Highest Hour	418	675	32	100
7th	Highest Hour	395	638	30	94
8th	Highest Hour	372	601	29	89
9th	Highest Hour	340	550	26	81
10th	Highest Hour	293	472	23	70
11th	Highest Hour	239	387	18	57
12th	Highest Hour	229	369	18	55
13th	Highest Hour	207	335	16	50
14th	Highest Hour	192	309	15	46
15th	Highest Hour	192	309	15	46
16th	Highest Hour	186	301	14	44
17th	Highest Hour	106	172	8	25
18th	Highest Hour	59	94	5	14
19th	Highest Hour	53	86	4	13
20th	Highest Hour	21	34	2	5
21st	Highest Hour	16	26	1	4
22nd	Highest Hour	16	26	1	4
23rd	Highest Hour	11	17	1	3
24th	Highest Hour	11	17	1	3

Warrant Summary

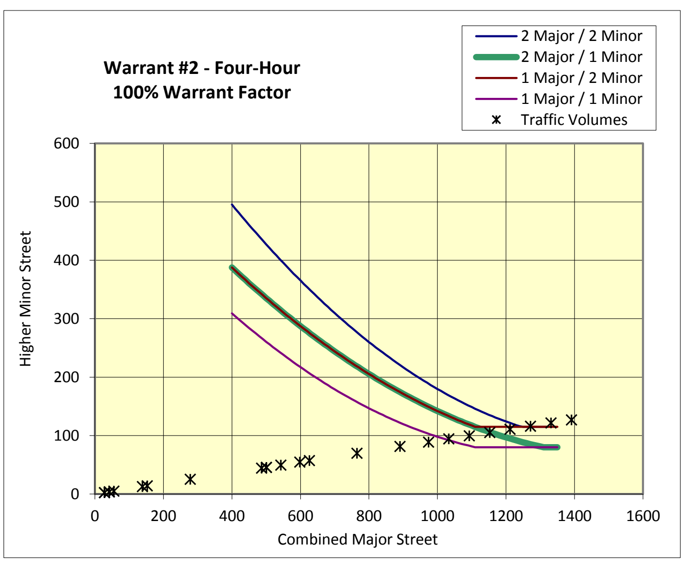
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**Yes**
	B	750	75	9	Yes	
80%	A	400	120	2	No	**Yes**
	B	600	60	10	Yes	
70%	A	350	105	5	No	**Yes**
	B	525	53	12	Yes	



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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Ona_TTPM.xls]Data Input
Intersection:	OR 211/Ona Way
Scenario:	2040 Future Traffic Conditions (Scen 1)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	1043	899	93	0
2nd	Highest Hour	998	860	89	0
3rd	Highest Hour	954	822	85	0
4th	Highest Hour	909	783	81	0
5th	Highest Hour	864	745	77	0
6th	Highest Hour	820	706	73	0
7th	Highest Hour	775	668	69	0
8th	Highest Hour	730	629	65	0
9th	Highest Hour	668	575	60	0
10th	Highest Hour	574	494	51	0
11th	Highest Hour	469	405	42	0
12th	Highest Hour	448	387	40	0
13th	Highest Hour	407	351	36	0
14th	Highest Hour	375	324	33	0
15th	Highest Hour	375	324	33	0
16th	Highest Hour	365	315	33	0
17th	Highest Hour	209	180	19	0
18th	Highest Hour	115	99	10	0
19th	Highest Hour	104	90	9	0
20th	Highest Hour	42	36	4	0
21st	Highest Hour	31	27	3	0
22nd	Highest Hour	31	27	3	0
23rd	Highest Hour	21	18	2	0
24th	Highest Hour	21	18	2	0

Warrant Summary

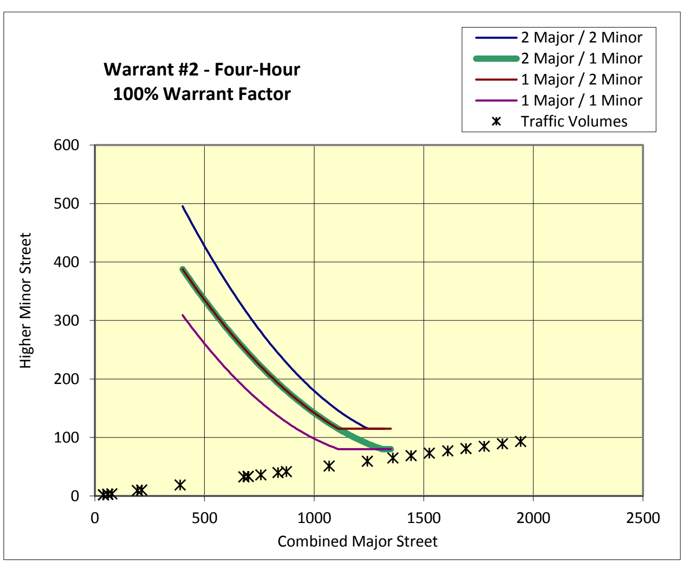
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

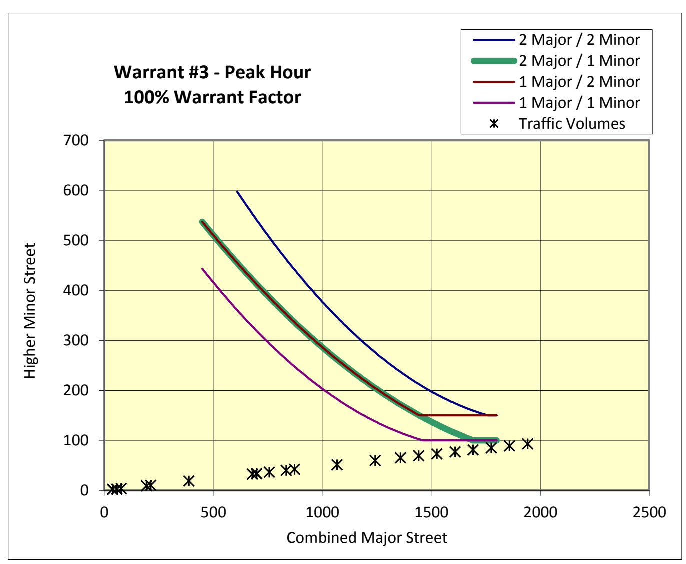
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**No**
	B	750	75	5	No	
80%	A	400	120	0	No	**Yes**
	B	600	60	9	Yes	
70%	A	350	105	0	No	**Yes**
	B	525	53	9	Yes	





KITTELSON & ASSOCIATES, INC.
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Leroy_TTPM.xls]Data Input
Intersection:	OR 211/Leroy Avenue
Scenario:	2040 Future Traffic Conditions (Scen 1)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	1096	780	0	52
2nd	Highest Hour	1049	747	0	50
3rd	Highest Hour	1002	713	0	48
4th	Highest Hour	955	680	0	45
5th	Highest Hour	908	646	0	43
6th	Highest Hour	861	613	0	41
7th	Highest Hour	814	579	0	39
8th	Highest Hour	767	546	0	36
9th	Highest Hour	701	499	0	33
10th	Highest Hour	603	429	0	29
11th	Highest Hour	493	351	0	23
12th	Highest Hour	471	335	0	22
13th	Highest Hour	427	304	0	20
14th	Highest Hour	395	281	0	19
15th	Highest Hour	395	281	0	19
16th	Highest Hour	384	273	0	18
17th	Highest Hour	219	156	0	10
18th	Highest Hour	121	86	0	6
19th	Highest Hour	110	78	0	5
20th	Highest Hour	44	31	0	2
21st	Highest Hour	33	23	0	2
22nd	Highest Hour	33	23	0	2
23rd	Highest Hour	22	16	0	1
24th	Highest Hour	22	16	0	1

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	No
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**No**
	B	750	75	0	No	
80%	A	400	120	0	No	**No**
	B	600	60	0	No	
70%	A	350	105	0	No	**No**
	B	525	53	0	No	

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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/26/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Molalla_TTPM.xls]Data Input
Intersection:	OR 211/Molalla Avenue
Scenario:	2040 Future Traffic Conditions (Scen 1)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	633	457	330	233
2nd	Highest Hour	606	437	316	223
3rd	Highest Hour	579	418	302	213
4th	Highest Hour	552	398	288	203
5th	Highest Hour	524	379	273	193
6th	Highest Hour	497	359	259	183
7th	Highest Hour	470	339	245	173
8th	Highest Hour	443	320	231	163
9th	Highest Hour	405	292	211	149
10th	Highest Hour	348	251	182	128
11th	Highest Hour	285	206	149	105
12th	Highest Hour	272	197	142	100
13th	Highest Hour	247	178	129	91
14th	Highest Hour	228	165	119	84
15th	Highest Hour	228	165	119	84
16th	Highest Hour	222	160	116	82
17th	Highest Hour	127	91	66	47
18th	Highest Hour	70	50	36	26
19th	Highest Hour	63	46	33	23
20th	Highest Hour	25	18	13	9
21st	Highest Hour	19	14	10	7
22nd	Highest Hour	19	14	10	7
23rd	Highest Hour	13	9	7	5
24th	Highest Hour	13	9	7	5

Warrant Summary

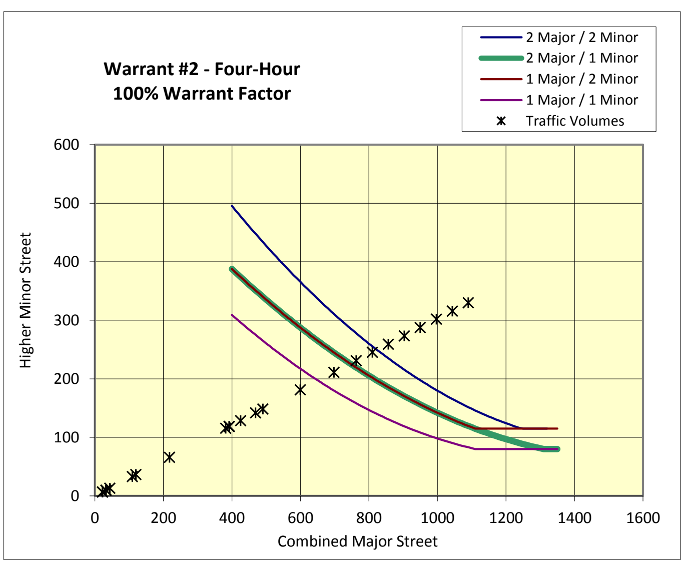
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

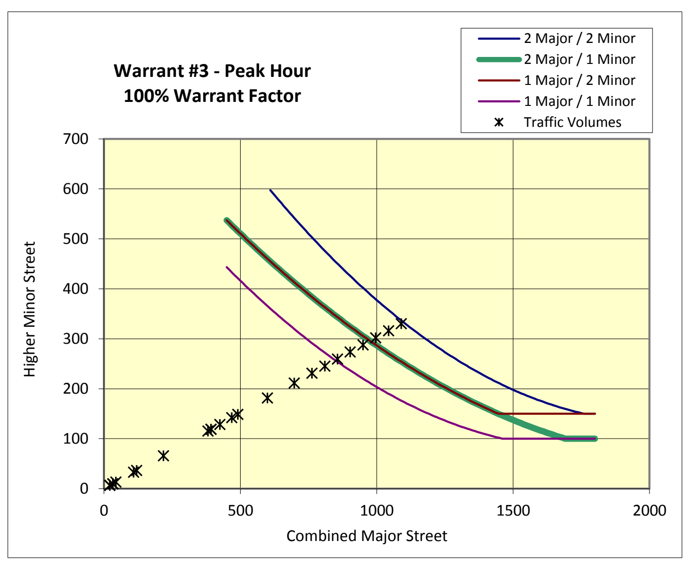
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	10	Yes	**Yes**
	B	750	75	8	Yes	
80%	A	400	120	13	Yes	**Yes**
	B	600	60	10	Yes	
70%	A	350	105	16	Yes	**Yes**
	B	525	53	10	Yes	





Attachment G Year 2040 Traffic Conditions Worksheets (Scenario 2)

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	0	0	15	0	17	0	531	23	48	980	0
Future Vol, veh/h	0	0	0	15	0	17	0	531	23	48	980	0
Conflicting Peds, #/hr	0	0	0	0	0	0	1	0	1	1	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	0	0	0	13	0	6	0	9	4	4	7	0
Mvmt Flow	0	0	0	16	0	18	0	565	24	51	1043	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1732	1736	1044	1723	1724	578	1044	0	0	590	0	0
Stage 1	1146	1146	-	578	578	-	-	-	-	-	-	-
Stage 2	586	590	-	1145	1146	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.23	6.5	6.26	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.23	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.23	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.617	4	3.354	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	70	88	281	66	90	508	674	-	-	976	-	-
Stage 1	245	276	-	483	504	-	-	-	-	-	-	-
Stage 2	500	498	-	231	276	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	61	77	281	60	79	508	674	-	-	976	-	-
Mov Cap-2 Maneuver	61	77	-	60	79	-	-	-	-	-	-	-
Stage 1	245	242	-	483	504	-	-	-	-	-	-	-
Stage 2	482	498	-	202	242	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	50	0	0.4
HCM LOS	A	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	674	-	-	-	113	976	-	-
HCM Lane V/C Ratio	-	-	-	-	0.301	0.052	-	-
HCM Control Delay (s)	0	-	-	0	50	8.9	0	-
HCM Lane LOS	A	-	-	A	F	A	A	-
HCM 95th %tile Q(veh)	0	-	-	-	1.2	0.2	-	-

Intersection	
Int Delay, s/veh	15

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	71	55	504	84	160	827
Future Vol, veh/h	71	55	504	84	160	827
Conflicting Peds, #/hr	0	0	0	1	1	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	100	150	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	4	8	9	5	1	9
Mvmt Flow	76	59	542	90	172	889

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1776	543	0	0	543	0
Stage 1	543	-	-	-	-	-
Stage 2	1233	-	-	-	-	-
Critical Hdwy	6.44	6.28	-	-	4.11	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.372	-	-	2.209	-
Pot Cap-1 Maneuver	90	528	-	-	1031	-
Stage 1	578	-	-	-	-	-
Stage 2	273	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 75	527	-	-	1031	-
Mov Cap-2 Maneuver	~ 75	-	-	-	-	-
Stage 1	577	-	-	-	-	-
Stage 2	227	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	190.9	0	1.5
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	120	1031	-
HCM Lane V/C Ratio	-	-	1.129	0.167	-
HCM Control Delay (s)	-	-	190.9	9.2	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	8.2	0.6	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	124.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	55	86	182	33	72	27	502	224	173	710	12
Future Vol, veh/h	10	55	86	182	33	72	27	502	224	173	710	12
Conflicting Peds, #/hr	0	0	1	1	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	0	4	2	2	0	2	4	9	20	11	8	0
Mvmt Flow	11	60	93	198	36	78	29	546	243	188	772	13

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1938	2003	780	1958	1888	667	786	0	0	789	0	0
Stage 1	1155	1155	-	726	726	-	-	-	-	-	-	-
Stage 2	783	848	-	1232	1162	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.54	6.22	7.12	6.5	6.22	4.14	-	-	4.21	-	-
Critical Hdwy Stg 1	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.54	-	6.12	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.036	3.318	3.518	4	3.318	2.236	-	-	2.299	-	-
Pot Cap-1 Maneuver	50	~ 59	395	~ 48	71	459	824	-	-	792	-	-
Stage 1	242	269	-	416	433	-	-	-	-	-	-	-
Stage 2	390	375	-	217	272	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 5	~ 32	394	-	38	459	823	-	-	792	-	-
Mov Cap-2 Maneuver	~ 5	~ 32	-	-	38	-	-	-	-	-	-	-
Stage 1	226	155	-	389	404	-	-	-	-	-	-	-
Stage 2	275	350	-	~ 59	157	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1707.9		0.3	2.1
HCM LOS	F	-		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	823	-	-	38	-	792	-	-
HCM Lane V/C Ratio	0.036	-	-	4.319	-	0.237	-	-
HCM Control Delay (s)	9.5	0		$ 1707.9	-	11	0	-
HCM Lane LOS	A	A	-	F	-	B	A	-
HCM 95th %tile Q(veh)	0.1	-	-	19	-	0.9	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	242	705	330	521	220	50	243	178	364	652
v/c Ratio	1.44	1.12	1.86	0.83	0.34	0.51	0.45	0.31	2.02	1.08
Control Delay	273.4	115.6	444.0	55.9	12.7	83.1	43.4	6.3	509.6	103.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	273.4	115.6	444.0	55.9	12.7	83.1	43.4	6.3	509.6	103.3
Queue Length 50th (ft)	~313	~774	~476	454	42	47	184	0	~539	~686
Queue Length 95th (ft)	#508	#1068	#697	#678	114	92	266	55	#768	#972
Internal Link Dist (ft)		1906		2602			1480			1933
Turn Bay Length (ft)	275		230		230	250		250	200	
Base Capacity (vph)	168	630	177	628	639	156	645	642	180	603
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.44	1.12	1.86	0.83	0.34	0.32	0.38	0.28	2.02	1.08

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	223	603	46	304	479	202	46	224	164	335	407	193
Future Volume (vph)	223	603	46	304	479	202	46	224	164	335	407	193
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1597	1796		1687	1776	1524	1492	1845	1504	1719	1691	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1597	1796		1687	1776	1524	1492	1845	1504	1719	1691	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	242	655	50	330	521	220	50	243	178	364	442	210
RTOR Reduction (vph)	0	2	0	0	0	101	0	0	124	0	11	0
Lane Group Flow (vph)	242	703	0	330	521	119	50	243	54	364	641	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	13%	5%	0%	7%	7%	6%	21%	3%	5%	5%	5%	11%
Turn Type	Prot	NA		Prot	NA	Perm	Prot	NA	Perm	Prot	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases						4			6			
Actuated Green, G (s)	15.0	50.1		15.0	50.6	50.6	8.3	43.4	43.4	15.0	50.1	
Effective Green, g (s)	15.0	50.1		15.0	50.6	50.6	8.3	43.4	43.4	15.0	50.1	
Actuated g/C Ratio	0.10	0.35		0.10	0.35	0.35	0.06	0.30	0.30	0.10	0.35	
Clearance Time (s)	4.5	5.3		5.0	5.3	5.3	5.0	5.3	5.3	5.0	5.3	
Vehicle Extension (s)	2.3	5.0		2.3	5.0	5.0	2.3	2.0	2.0	2.3	2.0	
Lane Grp Cap (vph)	166	624		175	623	535	85	555	452	178	587	
v/s Ratio Prot	0.15	c0.39		c0.20	0.29		0.03	0.13		c0.21	c0.38	
v/s Ratio Perm						0.08			0.04			
v/c Ratio	1.46	1.13		1.89	0.84	0.22	0.59	0.44	0.12	2.04	1.09	
Uniform Delay, d1	64.5	47.0		64.5	42.9	32.9	66.2	40.5	36.5	64.5	47.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	236.1	76.2		419.4	10.5	0.4	7.6	0.2	0.0	489.2	64.6	
Delay (s)	300.7	123.2		483.9	53.5	33.4	73.9	40.7	36.5	553.8	111.6	
Level of Service	F	F		F	D	C	E	D	D	F	F	
Approach Delay (s)		168.6			182.0			42.7			270.0	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM 2000 Control Delay	185.2	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.34		
Actuated Cycle Length (s)	144.1	Sum of lost time (s)	20.6
Intersection Capacity Utilization	105.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Intersection	
Int Delay, s/veh	2980.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	1147	144	136	1081	171	227
Future Vol, veh/h	1147	144	136	1081	171	227
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	93	93	93	93	93	93
Heavy Vehicles, %	5	0	0	6	0	0
Mvmt Flow	1233	155	146	1162	184	244

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1388	0	2766	1311
Stage 1	-	-	-	-	1311	-
Stage 2	-	-	-	-	1455	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	500	-	~ 22	~ 196
Stage 1	-	-	-	-	255	-
Stage 2	-	-	-	-	217	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	500	-	~ 4	~ 196
Mov Cap-2 Maneuver	-	-	-	-	~ 4	-
Stage 1	-	-	-	-	255	-
Stage 2	-	-	-	-	~ 38	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	$ 21753.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	9	-	-	500	-
HCM Lane V/C Ratio	47.551	-	-	0.292	-
HCM Control Delay (s)	$ 21753.8	-	-	15.1	0
HCM Lane LOS	F	-	-	C	A
HCM 95th %tile Q(veh)	55.3	-	-	1.2	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	39.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	236	1109	996	163	135	219
Future Vol, veh/h	236	1109	996	163	135	219
Conflicting Peds, #/hr	3	0	0	3	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	4	5	6	4	0	2
Mvmt Flow	251	1180	1060	173	144	233

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1236	0	-	0	2831	1149
Stage 1	-	-	-	-	1149	-
Stage 2	-	-	-	-	1682	-
Critical Hdwy	4.14	-	-	-	6.4	6.22
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.236	-	-	-	3.5	3.318
Pot Cap-1 Maneuver	557	-	-	-	~ 20	242
Stage 1	-	-	-	-	305	-
Stage 2	-	-	-	-	168	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	557	-	-	-	0	241
Mov Cap-2 Maneuver	-	-	-	-	0	-
Stage 1	-	-	-	-	304	-
Stage 2	-	-	-	-	0	-

Approach	EB	WB	SB
HCM Control Delay, s	2.9	0	$ 309.4
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	557	-	-	-	241
HCM Lane V/C Ratio	0.451	-	-	-	1.563
HCM Control Delay (s)	16.7	0	-	-	$ 309.4
HCM Lane LOS	C	A	-	-	F
HCM 95th %tile Q(veh)	2.3	-	-	-	23.1

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection						
Int Delay, s/veh	167.9					

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	115	1127	1040	68	61	116
Future Vol, veh/h	115	1127	1040	68	61	116
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	5	5	9	14	2
Mvmt Flow	120	1174	1083	71	64	121

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	1154	0	-	0	2533	1119
Stage 1	-	-	-	-	1119	-
Stage 2	-	-	-	-	1414	-
Critical Hdwy	4.1	-	-	-	6.54	6.22
Critical Hdwy Stg 1	-	-	-	-	5.54	-
Critical Hdwy Stg 2	-	-	-	-	5.54	-
Follow-up Hdwy	2.2	-	-	-	3.626	3.318
Pot Cap-1 Maneuver	613	-	-	-	~ 28	252
Stage 1	-	-	-	-	296	-
Stage 2	-	-	-	-	211	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	613	-	-	-	~ 12	252
Mov Cap-2 Maneuver	-	-	-	-	~ 12	-
Stage 1	-	-	-	-	296	-
Stage 2	-	-	-	-	92	-

Approach	EB	WB	SB
HCM Control Delay, s	1.1	0	$ 2388.7
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	613	-	-	-	32
HCM Lane V/C Ratio	0.195	-	-	-	5.762
HCM Control Delay (s)	12.3	0	-	-	$ 2388.7
HCM Lane LOS	B	A	-	-	F
HCM 95th %tile Q(veh)	0.7	-	-	-	22.2

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Intersection Delay, s/veh	366
Intersection LOS	F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	177	546	303	20	458	73	335	259	30	98	243	268
Future Vol, veh/h	177	546	303	20	458	73	335	259	30	98	243	268
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles, %	5	6	4	7	7	2	11	10	0	5	5	1
Mvmt Flow	184	569	316	21	477	76	349	270	31	102	253	279
Number of Lanes	0	1	1	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	2	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	2	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	2
HCM Control Delay	388.1	304	399.7	350.2
HCM LOS	F	F	F	F

Lane	NBLn1	EBLn1	EBLn2	WBLn1	SBLn1
Vol Left, %	54%	24%	0%	4%	16%
Vol Thru, %	42%	76%	0%	83%	40%
Vol Right, %	5%	0%	100%	13%	44%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	624	723	303	551	609
LT Vol	335	177	0	20	98
Through Vol	259	546	0	458	243
RT Vol	30	0	303	73	268
Lane Flow Rate	650	753	316	574	634
Geometry Grp	2	7	7	5	2
Degree of Util (X)	1.78	2.072	0.798	1.553	1.665
Departure Headway (Hd)	14.745	14.946	14.088	15.124	14.747
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	254	249	259	247	254
Service Time	12.745	12.646	11.788	13.124	12.747
HCM Lane V/C Ratio	2.559	3.024	1.22	2.324	2.496
HCM Control Delay	399.7	527.4	55.7	304	350.2
HCM Lane LOS	F	F	F	F	F
HCM 95th-tile Q	29.4	37.3	6.1	22.6	26.1

Intersection	
Int Delay, s/veh	13.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	73	346	126	0	314	9	140	7	0	2	9	46
Future Vol, veh/h	73	346	126	0	314	9	140	7	0	2	9	46
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	1	1	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	3	9	8	1	4	0	14	14	0	0	11	4
Mvmt Flow	79	376	137	0	341	10	152	8	0	2	10	50

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	353	0	0	-	-	0	979	956	-	956	1020	348
Stage 1	-	-	-	-	-	-	603	603	-	348	348	-
Stage 2	-	-	-	-	-	-	376	353	-	608	672	-
Critical Hdwy	4.13	-	-	-	-	-	7.24	6.64	-	7.1	6.61	6.24
Critical Hdwy Stg 1	-	-	-	-	-	-	6.24	5.64	-	6.1	5.61	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.24	5.64	-	6.1	5.61	-
Follow-up Hdwy	2.227	-	-	-	-	-	3.626	4.126	-	3.5	4.099	3.336
Pot Cap-1 Maneuver	1200	-	-	0	-	-	218	246	0	240	228	691
Stage 1	-	-	-	0	-	-	466	470	0	672	618	-
Stage 2	-	-	-	0	-	-	622	610	0	486	441	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1200	-	-	-	-	-	181	222	-	216	206	690
Mov Cap-2 Maneuver	-	-	-	-	-	-	181	222	-	216	206	-
Stage 1	-	-	-	-	-	-	422	426	-	608	617	-
Stage 2	-	-	-	-	-	-	568	609	-	432	400	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	1.1	0	88.6	13.7
HCM LOS			F	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBT	WBR	SBLn1
Capacity (veh/h)	183	1200	-	-	-	-	477
HCM Lane V/C Ratio	0.873	0.066	-	-	-	-	0.13
HCM Control Delay (s)	88.6	8.2	0	-	-	-	13.7
HCM Lane LOS	F	A	A	-	-	-	B
HCM 95th %tile Q(veh)	6.4	0.2	-	-	-	-	0.4

Intersection						
Int Delay, s/veh	1.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	44	21	33	404	379	70
Future Vol, veh/h	44	21	33	404	379	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	9	0	7	6	5	4
Mvmt Flow	46	22	35	425	399	74

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	931	436	473	0	-	0
Stage 1	436	-	-	-	-	-
Stage 2	495	-	-	-	-	-
Critical Hdwy	6.49	6.2	4.17	-	-	-
Critical Hdwy Stg 1	5.49	-	-	-	-	-
Critical Hdwy Stg 2	5.49	-	-	-	-	-
Follow-up Hdwy	3.581	3.3	2.263	-	-	-
Pot Cap-1 Maneuver	288	625	1063	-	-	-
Stage 1	637	-	-	-	-	-
Stage 2	598	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	276	625	1063	-	-	-
Mov Cap-2 Maneuver	276	-	-	-	-	-
Stage 1	637	-	-	-	-	-
Stage 2	572	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.4	0.6	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1063	-	337	-	-
HCM Lane V/C Ratio	0.033	-	0.203	-	-
HCM Control Delay (s)	8.5	0	18.4	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.7	-	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	21	53	18	193	316	7
Future Vol, veh/h	21	53	18	193	316	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	89	89	89	89	89	89
Heavy Vehicles, %	0	0	6	5	3	0
Mvmt Flow	24	60	20	217	355	8

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	616	359	363	0	-	0
Stage 1	359	-	-	-	-	-
Stage 2	257	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.16	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.254	-	-	-
Pot Cap-1 Maneuver	457	690	1174	-	-	-
Stage 1	711	-	-	-	-	-
Stage 2	791	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	448	690	1174	-	-	-
Mov Cap-2 Maneuver	448	-	-	-	-	-
Stage 1	711	-	-	-	-	-
Stage 2	776	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1174	-	598	-	-
HCM Lane V/C Ratio	0.017	-	0.139	-	-
HCM Control Delay (s)	8.1	0	12	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.5	-	-

Intersection	
Int Delay, s/veh	20.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	67	319	297	202	300	74
Future Vol, veh/h	67	319	297	202	300	74
Conflicting Peds, #/hr	0	3	3	0	0	3
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	25	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	96	96	96	96	96	96
Heavy Vehicles, %	0	1	4	2	3	3
Mvmt Flow	70	332	309	210	313	77

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1183	357	393	0	-	0
Stage 1	354	-	-	-	-	-
Stage 2	829	-	-	-	-	-
Critical Hdwy	6.4	6.21	4.14	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.309	2.236	-	-	-
Pot Cap-1 Maneuver	211	689	1155	-	-	-
Stage 1	715	-	-	-	-	-
Stage 2	432	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	154	685	1152	-	-	-
Mov Cap-2 Maneuver	154	-	-	-	-	-
Stage 1	713	-	-	-	-	-
Stage 2	315	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	60.4	5.5	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1152	-	429	-	-
HCM Lane V/C Ratio	0.269	-	0.937	-	-
HCM Control Delay (s)	9.3	-	60.4	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	1.1	-	10.7	-	-

Intersection						
Int Delay, s/veh	44.1					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	168	106	392	173	147	479
Future Vol, veh/h	168	106	392	173	147	479
Conflicting Peds, #/hr	0	0	0	4	4	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	25	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	10	5	4	0	5	2
Mvmt Flow	171	108	400	177	150	489

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1281	492	0	0	581	0
Stage 1	492	-	-	-	-	-
Stage 2	789	-	-	-	-	-
Critical Hdwy	6.5	6.25	-	-	4.15	-
Critical Hdwy Stg 1	5.5	-	-	-	-	-
Critical Hdwy Stg 2	5.5	-	-	-	-	-
Follow-up Hdwy	3.59	3.345	-	-	2.245	-
Pot Cap-1 Maneuver	176	571	-	-	978	-
Stage 1	598	-	-	-	-	-
Stage 2	434	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	~ 148	569	-	-	978	-
Mov Cap-2 Maneuver	~ 148	-	-	-	-	-
Stage 1	596	-	-	-	-	-
Stage 2	367	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	230.9	0	2.2
HCM LOS	F		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	207	978	-
HCM Lane V/C Ratio	-	-	1.351	0.153	-
HCM Control Delay (s)	-	-	230.9	9.3	-
HCM Lane LOS	-	-	F	A	-
HCM 95th %tile Q(veh)	-	-	15.7	0.5	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	14.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Future Vol, veh/h	10	29	31	44	23	80	26	482	16	99	528	27
Conflicting Peds, #/hr	3	0	6	6	0	3	4	0	5	5	0	4
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	7	0	0	3	17	3	0	0	2	0
Mvmt Flow	10	30	32	46	24	83	27	502	17	103	550	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1395	1352	574	1378	1358	518	582	0	0	524	0	0
Stage 1	774	774	-	570	570	-	-	-	-	-	-	-
Stage 2	621	578	-	808	788	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.27	7.1	6.5	6.23	4.27	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.363	3.5	4	3.327	2.353	-	-	2.2	-	-
Pot Cap-1 Maneuver	120	151	509	123	150	556	922	-	-	1053	-	-
Stage 1	394	411	-	510	509	-	-	-	-	-	-	-
Stage 2	478	504	-	378	405	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	74	123	504	80	122	552	917	-	-	1050	-	-
Mov Cap-2 Maneuver	74	123	-	80	122	-	-	-	-	-	-	-
Stage 1	376	350	-	487	486	-	-	-	-	-	-	-
Stage 2	369	481	-	275	345	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	44.2	105.7	0.4	1.3
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	917	-	-	162	166	1050	-	-
HCM Lane V/C Ratio	0.03	-	-	0.45	0.922	0.098	-	-
HCM Control Delay (s)	9	0	-	44.2	105.7	8.8	0	-
HCM Lane LOS	A	A	-	E	F	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	2.1	6.8	0.3	-	-

Intersection	
Int Delay, s/veh	205.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Future Vol, veh/h	130	81	6	25	62	312	1	125	28	239	235	88
Conflicting Peds, #/hr	5	0	0	0	0	5	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	3	33	6	0	0	0	4	5	4	2	0
Mvmt Flow	144	90	7	28	69	347	1	139	31	266	261	98

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1210	1015	310	1048	1049	161	359	0	0	172	0	0
Stage 1	841	841	-	159	159	-	-	-	-	-	-	-
Stage 2	369	174	-	889	890	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.53	6.53	7.16	6.5	6.2	4.1	-	-	4.14	-	-
Critical Hdwy Stg 1	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.53	-	6.16	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4.027	3.597	3.554	4	3.3	2.2	-	-	2.236	-	-
Pot Cap-1 Maneuver	161	237	663	202	229	889	1211	-	-	1393	-	-
Stage 1	362	379	-	834	770	-	-	-	-	-	-	-
Stage 2	655	753	-	332	364	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	~ 55	179	663	100	173	883	1211	-	-	1386	-	-
Mov Cap-2 Maneuver	~ 55	179	-	100	173	-	-	-	-	-	-	-
Stage 1	362	287	-	832	768	-	-	-	-	-	-	-
Stage 2	360	751	-	171	276	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 1075.2	95.4	0.1	3.5
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1211	-	-	77	415	1386	-	-
HCM Lane V/C Ratio	0.001	-	-	3.131	1.068	0.192	-	-
HCM Control Delay (s)	8	0		$ 1075.2	95.4	8.2	-	-
HCM Lane LOS	A	A	-	F	F	A	-	-
HCM 95th %tile Q(veh)	0	-	-	24.2	14.8	0.7	-	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection						
Int Delay, s/veh	2.5					

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	64	22	13	134	157	62
Future Vol, veh/h	64	22	13	134	157	62
Conflicting Peds, #/hr	0	4	4	0	0	4
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	82	82	82	82	82	82
Heavy Vehicles, %	0	5	0	6	3	0
Mvmt Flow	78	27	16	163	191	76

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	428	237	271	0	-	0
Stage 1	233	-	-	-	-	-
Stage 2	195	-	-	-	-	-
Critical Hdwy	6.4	6.25	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.345	2.2	-	-	-
Pot Cap-1 Maneuver	588	795	1304	-	-	-
Stage 1	810	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	575	789	1299	-	-	-
Mov Cap-2 Maneuver	575	-	-	-	-	-
Stage 1	807	-	-	-	-	-
Stage 2	828	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	12	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1299	-	618	-	-
HCM Lane V/C Ratio	0.012	-	0.17	-	-
HCM Control Delay (s)	7.8	0	12	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

Attachment H Signal Warrant Worksheets

KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
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(503) 228-5230
Fax: (503) 273-8169

Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_213_Meadow_TTPM_S2.xls]Data Input
Intersection:	OR 213/Meadow Drive
Scenario:	2040 Forecast Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	504	987	0	71
2nd	Highest Hour	482	945	0	68
3rd	Highest Hour	461	902	0	65
4th	Highest Hour	439	860	0	62
5th	Highest Hour	418	818	0	59
6th	Highest Hour	396	776	0	56
7th	Highest Hour	374	733	0	53
8th	Highest Hour	353	691	0	50
9th	Highest Hour	323	632	0	45
10th	Highest Hour	277	543	0	39
11th	Highest Hour	227	444	0	32
12th	Highest Hour	217	424	0	31
13th	Highest Hour	197	385	0	28
14th	Highest Hour	181	355	0	26
15th	Highest Hour	181	355	0	26
16th	Highest Hour	176	345	0	25
17th	Highest Hour	101	197	0	14
18th	Highest Hour	55	109	0	8
19th	Highest Hour	50	99	0	7
20th	Highest Hour	20	39	0	3
21st	Highest Hour	15	30	0	2
22nd	Highest Hour	15	30	0	2
23rd	Highest Hour	10	20	0	1
24th	Highest Hour	10	20	0	1

Warrant Summary

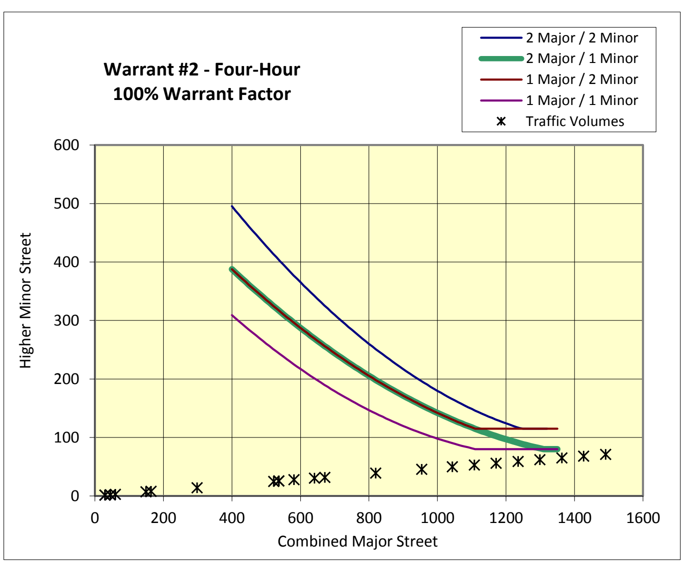
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	No
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

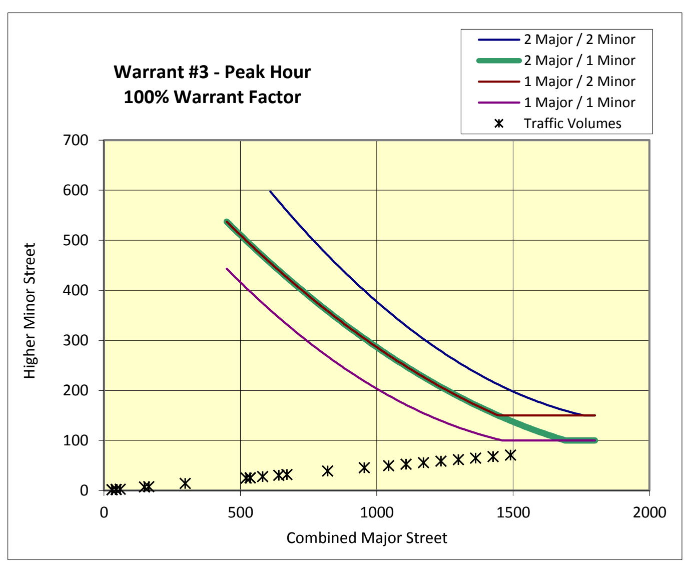
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**No**
	B	750	75	0	No	
80%	A	400	120	0	No	**No**
	B	600	60	4	No	
70%	A	350	105	0	No	**No**
	B	525	53	7	No	





KITTELSON & ASSOCIATES, INC.
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/26/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Ona_TTPM2.xls]Data Input
Intersection:	OR 211/Ona Way
Scenario:	2040 Future Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	1147	1217	171	0
2nd	Highest Hour	1098	1165	164	0
3rd	Highest Hour	1049	1113	156	0
4th	Highest Hour	1000	1061	149	0
5th	Highest Hour	950	1008	142	0
6th	Highest Hour	901	956	134	0
7th	Highest Hour	852	904	127	0
8th	Highest Hour	803	852	120	0
9th	Highest Hour	734	779	109	0
10th	Highest Hour	631	669	94	0
11th	Highest Hour	516	548	77	0
12th	Highest Hour	493	523	74	0
13th	Highest Hour	447	475	67	0
14th	Highest Hour	413	438	62	0
15th	Highest Hour	413	438	62	0
16th	Highest Hour	401	426	60	0
17th	Highest Hour	229	243	34	0
18th	Highest Hour	126	134	19	0
19th	Highest Hour	115	122	17	0
20th	Highest Hour	46	49	7	0
21st	Highest Hour	34	37	5	0
22nd	Highest Hour	34	37	5	0
23rd	Highest Hour	23	24	3	0
24th	Highest Hour	23	24	3	0

Warrant Summary

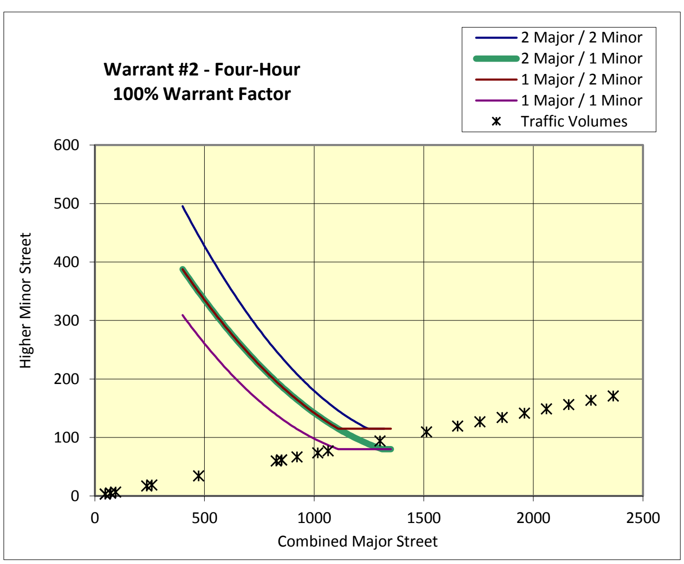
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

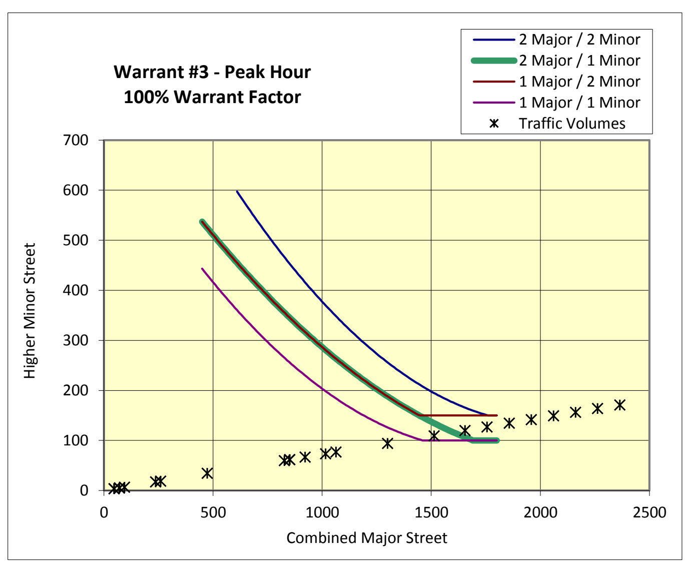
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	4	No	Yes
	B	750	75	11	Yes	
80%	A	400	120	8	Yes	Yes
	B	600	60	16	Yes	
70%	A	350	105	9	Yes	Yes
	B	525	53	16	Yes	





KITTELSON & ASSOCIATES, INC.
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/26/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Leroy_TTPM2.xls]War #3 - Peak HR
Intersection:	OR 211/Leroy Avenue
Scenario:	2040 Future Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	1345	996	0	135
2nd	Highest Hour	1287	953	0	129
3rd	Highest Hour	1230	911	0	123
4th	Highest Hour	1172	868	0	118
5th	Highest Hour	1114	825	0	112
6th	Highest Hour	1057	783	0	106
7th	Highest Hour	999	740	0	100
8th	Highest Hour	942	697	0	95
9th	Highest Hour	861	637	0	86
10th	Highest Hour	740	548	0	74
11th	Highest Hour	605	448	0	61
12th	Highest Hour	578	428	0	58
13th	Highest Hour	525	388	0	53
14th	Highest Hour	484	359	0	49
15th	Highest Hour	484	359	0	49
16th	Highest Hour	471	349	0	47
17th	Highest Hour	269	199	0	27
18th	Highest Hour	148	110	0	15
19th	Highest Hour	135	100	0	14
20th	Highest Hour	54	40	0	5
21st	Highest Hour	40	30	0	4
22nd	Highest Hour	40	30	0	4
23rd	Highest Hour	27	20	0	3
24th	Highest Hour	27	20	0	3

Warrant Summary

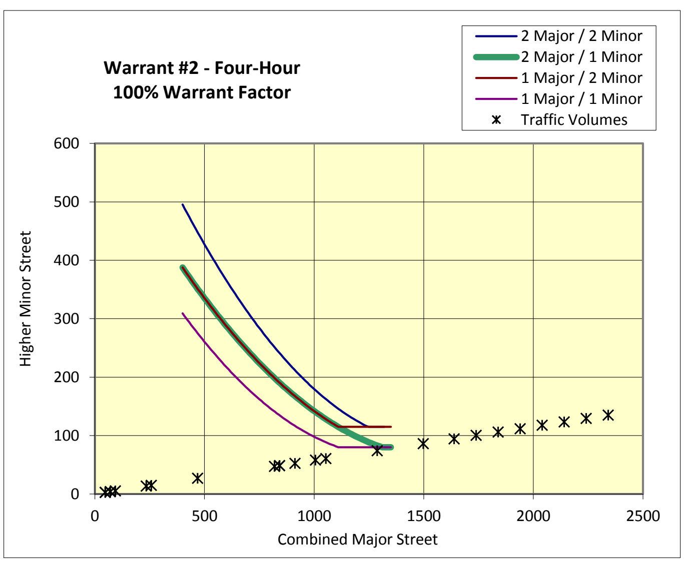
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**Yes**
	B	750	75	10	Yes	
80%	A	400	120	3	No	**Yes**
	B	600	60	11	Yes	
70%	A	350	105	6	No	**Yes**
	B	525	53	13	Yes	



KITTELSON & ASSOCIATES, INC.
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_211_Ridings_TTPM_S2.xls]Data Input
Intersection:	OR 211/Ridings Avenue
Scenario:	2040 Forecast Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	1242	1040	0	61
2nd	Highest Hour	1189	995	0	58
3rd	Highest Hour	1136	951	0	56
4th	Highest Hour	1082	906	0	53
5th	Highest Hour	1029	862	0	51
6th	Highest Hour	976	817	0	48
7th	Highest Hour	923	773	0	45
8th	Highest Hour	869	728	0	43
9th	Highest Hour	795	666	0	39
10th	Highest Hour	683	572	0	34
11th	Highest Hour	559	468	0	27
12th	Highest Hour	534	447	0	26
13th	Highest Hour	484	406	0	24
14th	Highest Hour	447	374	0	22
15th	Highest Hour	447	374	0	22
16th	Highest Hour	435	364	0	21
17th	Highest Hour	248	208	0	12
18th	Highest Hour	137	114	0	7
19th	Highest Hour	124	104	0	6
20th	Highest Hour	50	42	0	2
21st	Highest Hour	37	31	0	2
22nd	Highest Hour	37	31	0	2
23rd	Highest Hour	25	21	0	1
24th	Highest Hour	25	21	0	1

Warrant Summary

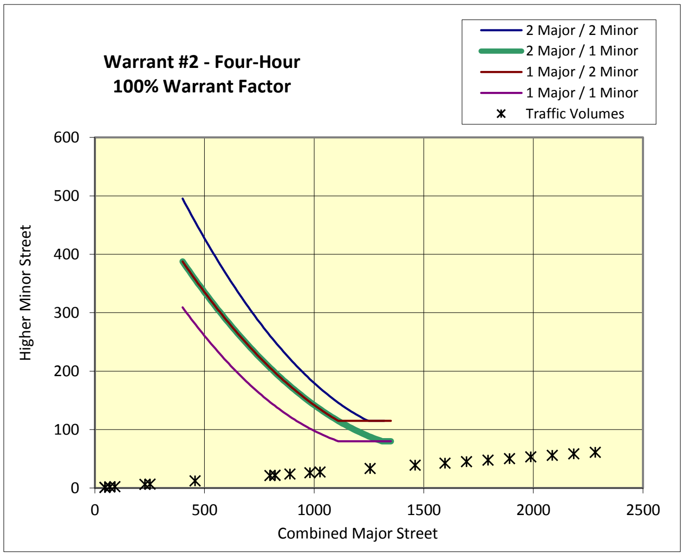
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	No
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

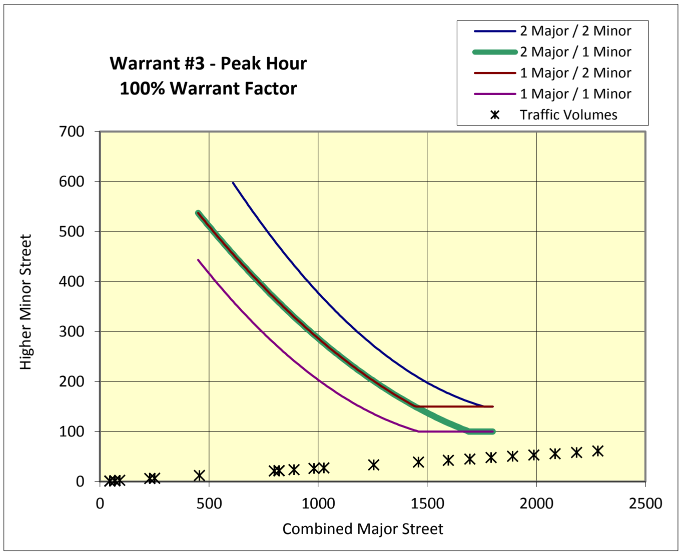
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**No**
	B	750	75	0	No	
80%	A	400	120	0	No	**No**
	B	600	60	1	No	
70%	A	350	105	0	No	**No**
	B	525	53	4	No	





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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_Molalla_Shirley_TTPM_S2.xls]War #3 - Peak HR
Intersection:	N Molalla Avenue/Shirley Street
Scenario:	2040 Forecast Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	392	626	0	168
2nd	Highest Hour	375	599	0	161
3rd	Highest Hour	358	572	0	154
4th	Highest Hour	342	546	0	146
5th	Highest Hour	325	519	0	139
6th	Highest Hour	308	492	0	132
7th	Highest Hour	291	465	0	125
8th	Highest Hour	274	438	0	118
9th	Highest Hour	251	401	0	108
10th	Highest Hour	216	344	0	92
11th	Highest Hour	176	282	0	76
12th	Highest Hour	169	269	0	72
13th	Highest Hour	153	244	0	66
14th	Highest Hour	141	225	0	60
15th	Highest Hour	141	225	0	60
16th	Highest Hour	137	219	0	59
17th	Highest Hour	78	125	0	34
18th	Highest Hour	43	69	0	18
19th	Highest Hour	39	63	0	17
20th	Highest Hour	16	25	0	7
21st	Highest Hour	12	19	0	5
22nd	Highest Hour	12	19	0	5
23rd	Highest Hour	8	13	0	3
24th	Highest Hour	8	13	0	3

Warrant Summary

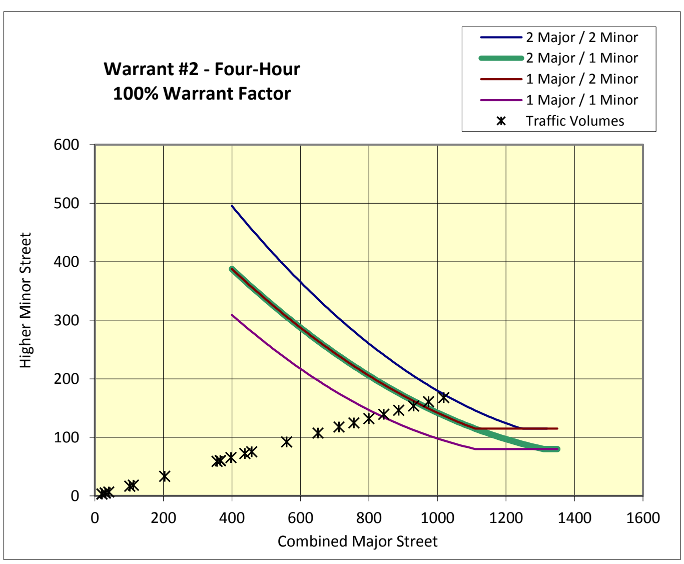
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

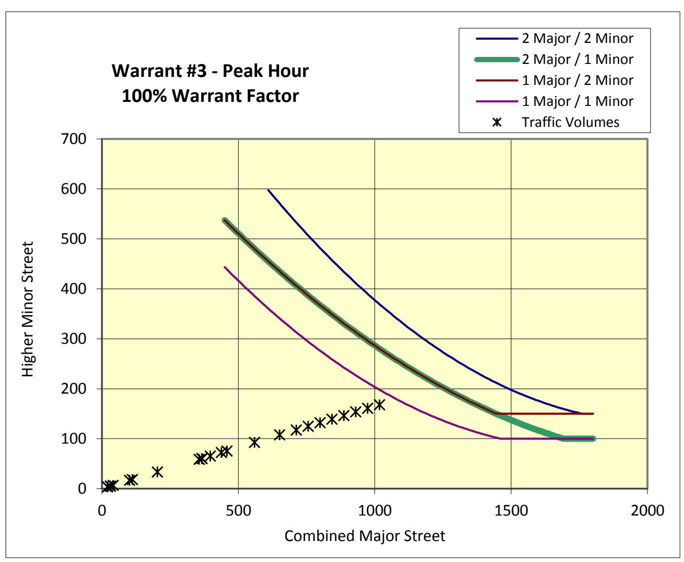
Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	3	No	No
	B	750	75	7	No	
80%	A	400	120	7	No	Yes
	B	600	60	9	Yes	
70%	A	350	105	9	Yes	Yes
	B	525	53	10	Yes	





KITTELSON & ASSOCIATES, INC.
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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/26/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_Molalla_Heintz_TTPM_S2.xls]Data Input
Intersection:	N Molalla Avenue/Heintz Street
Scenario:	2040 Forecast Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	508	627	39	67
2nd	Highest Hour	486	600	37	64
3rd	Highest Hour	464	573	36	61
4th	Highest Hour	443	546	34	58
5th	Highest Hour	421	520	32	56
6th	Highest Hour	399	493	31	53
7th	Highest Hour	377	466	29	50
8th	Highest Hour	356	439	27	47
9th	Highest Hour	325	401	25	43
10th	Highest Hour	279	345	21	37
11th	Highest Hour	229	282	18	30
12th	Highest Hour	218	270	17	29
13th	Highest Hour	198	245	15	26
14th	Highest Hour	183	226	14	24
15th	Highest Hour	183	226	14	24
16th	Highest Hour	178	219	14	23
17th	Highest Hour	102	125	8	13
18th	Highest Hour	56	69	4	7
19th	Highest Hour	51	63	4	7
20th	Highest Hour	20	25	2	3
21st	Highest Hour	15	19	1	2
22nd	Highest Hour	15	19	1	2
23rd	Highest Hour	10	13	1	1
24th	Highest Hour	10	13	1	1

Warrant Summary

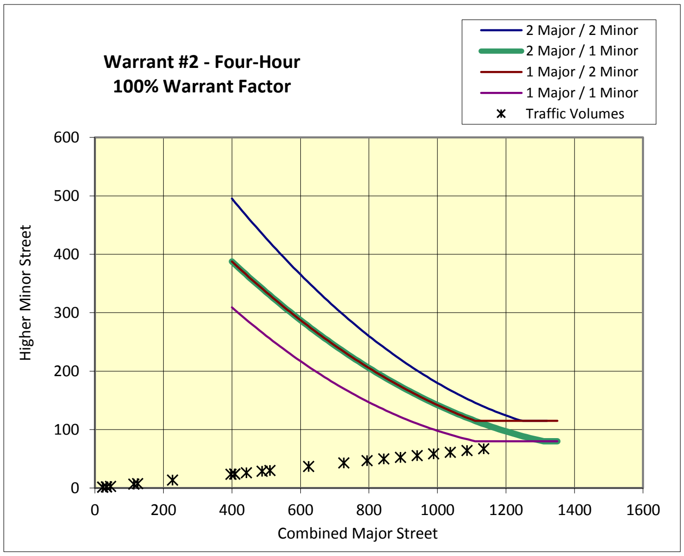
Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	No
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	0	No	**No**
	B	750	75	0	No	
80%	A	400	120	0	No	**No**
	B	600	60	3	No	
70%	A	350	105	0	No	**No**
	B	525	53	6	No	



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Project #:	21266
Project Name:	Molalla TSP Update
Analyst:	KAI
Date:	3/23/2018
File:	H:\21\21266 - Molalla TSP Update\excel\[Signal Warrant Analysis_Molalla_5th_TTPM_S2.xls]Data Input
Intersection:	S Molalla Avenue/5th Street
Scenario:	2040 Forecast Traffic Conditions (Scen 2)

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	126	474	211	87
2nd	Highest Hour	121	454	202	83
3rd	Highest Hour	115	433	193	80
4th	Highest Hour	110	413	184	76
5th	Highest Hour	104	393	175	72
6th	Highest Hour	99	372	166	68
7th	Highest Hour	94	352	157	65
8th	Highest Hour	88	332	148	61
9th	Highest Hour	81	303	135	56
10th	Highest Hour	69	261	116	48
11th	Highest Hour	57	213	95	39
12th	Highest Hour	54	204	91	37
13th	Highest Hour	49	185	82	34
14th	Highest Hour	45	171	76	31
15th	Highest Hour	45	171	76	31
16th	Highest Hour	44	166	74	30
17th	Highest Hour	25	95	42	17
18th	Highest Hour	14	52	23	10
19th	Highest Hour	13	47	21	9
20th	Highest Hour	5	19	8	3
21st	Highest Hour	4	14	6	3
22nd	Highest Hour	4	14	6	3
23rd	Highest Hour	3	9	4	2
24th	Highest Hour	3	9	4	2

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	No
#2	Four-Hour Vehicular volume	Yes	No
#3	Peak Hour	Yes	Yes*
#4	Pedestrian Volume	No	.
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	87%
Major Street: 8th-Highest Hour / Peak Hour	70%
Minor Street: 4th-Highest Hour / Peak Hour	87%
Minor Street: 8th-Highest Hour / Peak Hour	70%

Warrant #1 - Eight Hour

Warrant Factor	Condition	Major Street Requirement	Minor Street Requirement	Hours That Condition Is Met	Condition for Warrant Factor Met?	Signal Warrant Met?
100%	A	500	150	4	No	**No**
	B	750	75	0	No	
80%	A	400	120	8	Yes	**Yes**
	B	600	60	1	No	
70%	A	350	105	9	Yes	**Yes**
	B	525	53	3	No